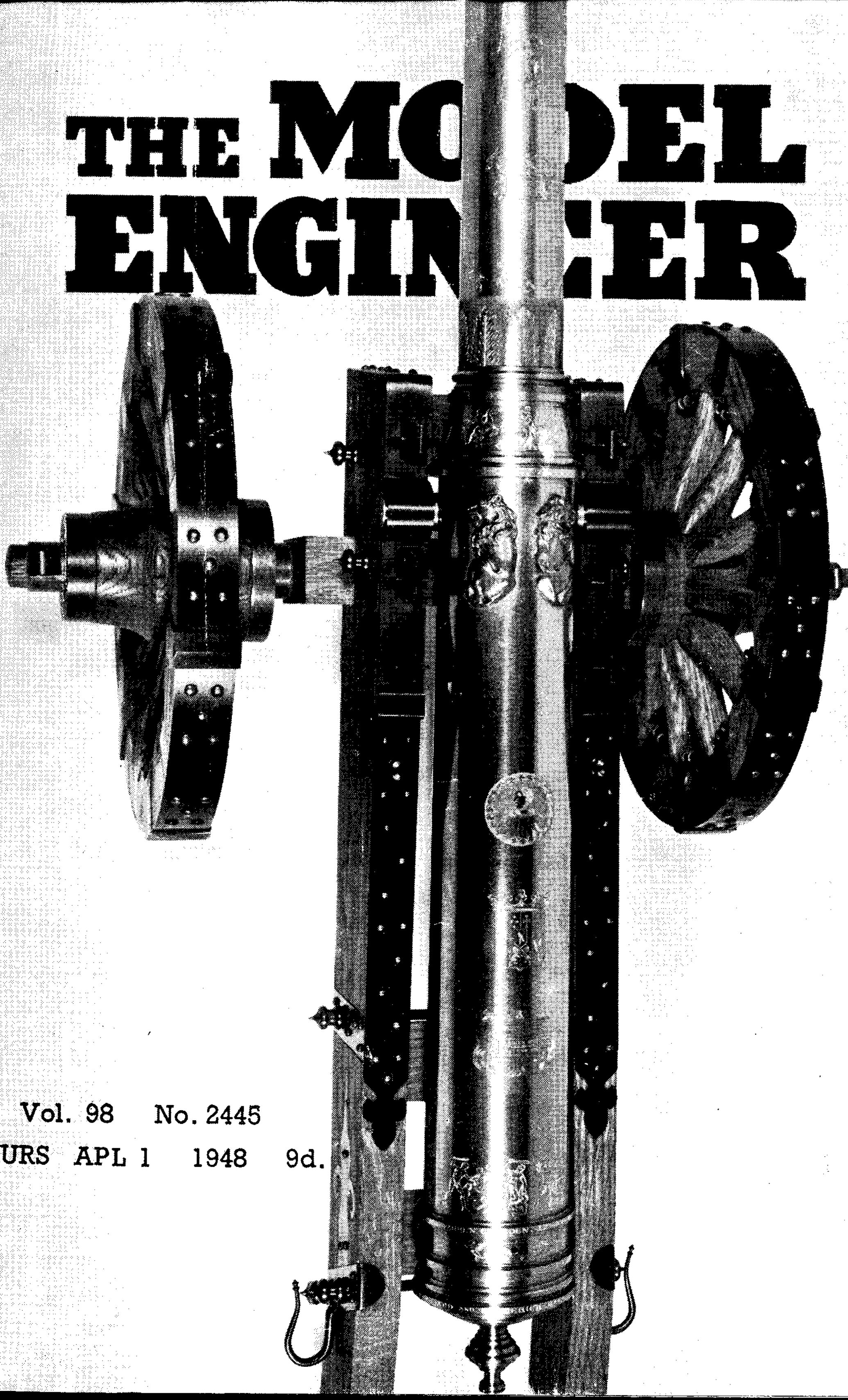
THE MODEL ENGINEER



Vol. 98 No. 2445

THURS APL 1 1948 9d.

The MODEL ENGINEER

PERCIVAL MARSHALL & CO. LTD., 23, GREAT QUEEN ST., LONDON, W.C.2

1ST APRIL 1948

VOL. 98. NO. 2445

SMOKE RINGS

Referendum Correspondence

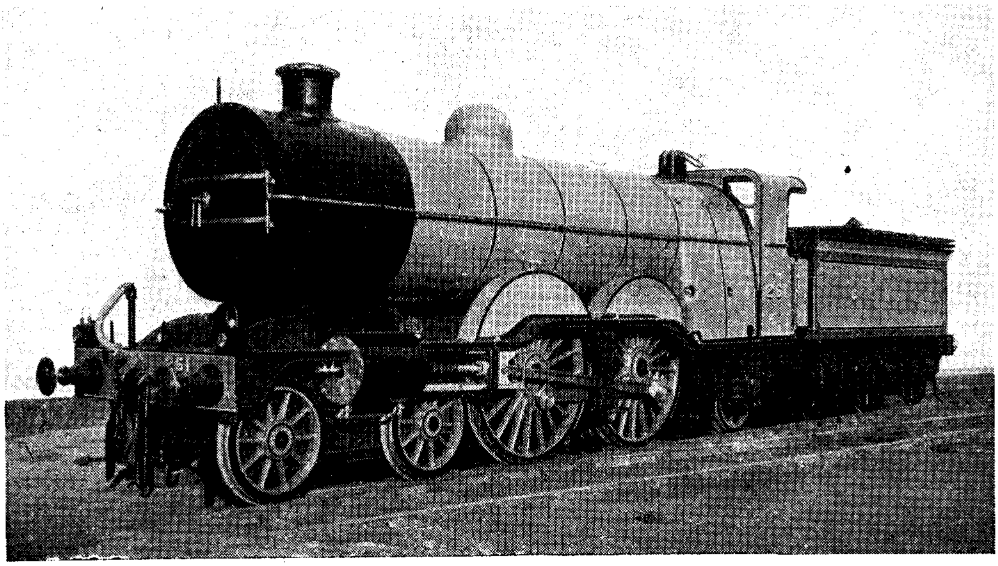
● THE RESPONSE to our Referendum has been truly magnificent, and completed pages from our issue of February 19th continue to pour in from all parts of the world. It seems that many readers considered the space at the foot of the page allocated to " Any other comments " insufficient, and to supplement their remarks enclosed a letter with their completed form. Many of these letters deal with matters other than the Referendum, and where this is so, replies have been or will be sent, but we have found it impossible to reply to the many hundreds of letters which are simply an enlargement of readers' views or comprise a number of constructive suggestions. We would like to take this opportunity, therefore, of thanking all those who have written, and to assure them that their suggestions and views will be carefully studied; and, so far as they coincide with the wishes of the majority, our future presentation will be modified and amended to conform.

A National Collection of Marine Photographs

● MODEL-MAKING automatically causes one to search for details of the prototype being modelled, and the keen model-maker rarely goes abroad without his camera or sketchbook. Photographs constitute the most valuable and authentic record of a ship or machine, and the older generation of model-makers must possess records of things now past and gone which are unique. With this idea in mind, the Society for Nautical Research is making an appeal to ship model makers to help with photographs of old sailing ships and steamers, in the formation of a national collection, which will be of inestimable value to all ship modellers, not to mention its value to the research workers of future generations. Prints or negatives may be given or loaned, as the idea is ultimately to make photographic copies on microfilm. By this process, literally millions of negatives could be stored, any one of which would be instantly available for projection on a screen or for enlarging as a print for either consultation or purchase as may be desired. The collection will be kept at the National Maritime Museum, and will be indexed and operated by the Society of Nautical Research; it will be accessible to any responsible ship modeller. Any trouble or sacrifice which may be entailed in contributing material to the collection, will be more than repaid by the accessibility of quantities of photographs far beyond the dreams of the most ambitious individual collector. Material should be addressed to the Photographic Record Sub-committee, Society for Nautical Research, National Maritime Museum, Greenwich, S.E.10.

More Locomotives Preserved

● LOCOMOTIVE ENTHUSIASTS will have learnt with pleasure of the recent additions to the number of locomotives that have been saved from being scrapped; they are: The old L.B. & S.C.R. No. 82, *Boxhill*, the subject of an illustrated article by Mr. J. N. Maskelyne in THE MODEL ENGINEER for January 22nd last; the *ex*-N.E.R. 4-4-0 engine No. 1621, and the *ex*-G.N.R. Atlantic No. 251. The last-named has been restored, like *Boxhill*, to as nearly as possible its original condition, and it is painted in the style which was then the G.N.R. standard. The result, according to reports, is thoroughly satisfying, and there can be no doubt that all those many enthusiasts who have been thrilled by the exciting performances of the Ivatt Atlantics, especially during the last twenty-five years, will be more than gratified that No. 251 is to be kept as a reminder of a glorious past. No. 251 was built at Doncaster in 1902 and was withdrawn from service in 1947; about thirty years ago she was fitted with a superheater and generally modernised, though the external appearance remained almost unaltered. As "restored," the engine has had the superheater removed, and Mr. Maskelyne reports that the only visible inaccuracy is that the chimney is one of the modern ones with flattened top; presumably, it is now impossible to obtain a casting of the original shape of chimney without making a new pattern!



A Proposed Club for Auckland, N.Z.

● MR. GORDON GUBB of East Tamaki Road, Papatoetoe, Auckland, New Zealand, writes us to say that he cannot find that any model engineering club exists in the district in which he resides, but a small group of enthusiasts are trying to organise something which may enable lone hands in the area to make contact with each other. If a club is already in existence, or if there are others who favour the idea of a club, perhaps they would write to Mr. Gubb so that something can be done. Mr. Gubb sent us a photograph of the interior of his workshop, showing what appears to be a very fine drilling machine made at night school from castings and materials supplied by the school.

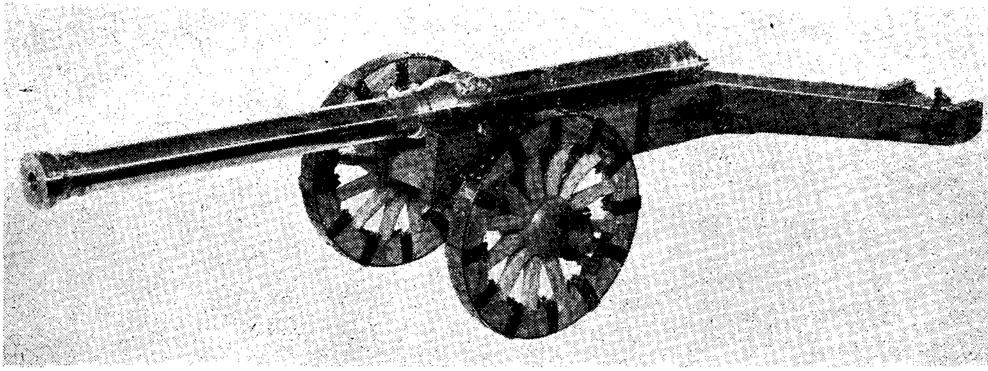
A Barnsley "At Home" Day

● I HEAR from Messrs. T. Garner & Son Ltd., of Redbrook Works, Gawber, Barnsley, that they will be holding an "at home" day on Saturday, April 10th, from 10 a.m. to 7 p.m. This will take place at the Y.M.C.A., Eldon Street, Barnsley, when all visitors will be welcome. The purpose is to demonstrate small lathes under actual working conditions, with an adequate works staff in attendance to give information and practical advice.

The Daimler Company Limited

● MR. S. L. POOLE asks me to make a correction to our recent review of *Daimler—1896 to 1946*. He points out that the correct title of this world-famous organisation is "The Daimler Company Limited" and not "Daimler Motor Co. Ltd." or "Daimler Limited." The importance of the correction lies in the fact that the Company was so named to indicate that they were the holders of the patents for the original Daimler engine, and are naturally very proud of this mark of a great tradition. We like to be correct, so my apologies to all concerned.

Percival Marshall



Famous Cannon Models

by Warren G. Ogden Jnr.

WE are indebted to Mr. Ogden for these photographs of model cannon which he has made in his basement workshop.

Referring to the picture, which we have used as our cover illustration this week, Mr. Ogden writes :

"This model was started before the Hitler war. The barrel is a bronze casting with a ⅝ in. bore, 33-in. deep. Cost of the casting was around 22 dollars at that time, the wheels are 9¼-in. diameter. Overall length of model about 52 in.

"It is a model of the famous Culverine of Nancy, cast in 1598, by Jean de Chaligny. Its length was 21 ft. 11 in. and 6 lines. Fired an 18-lb. ball.

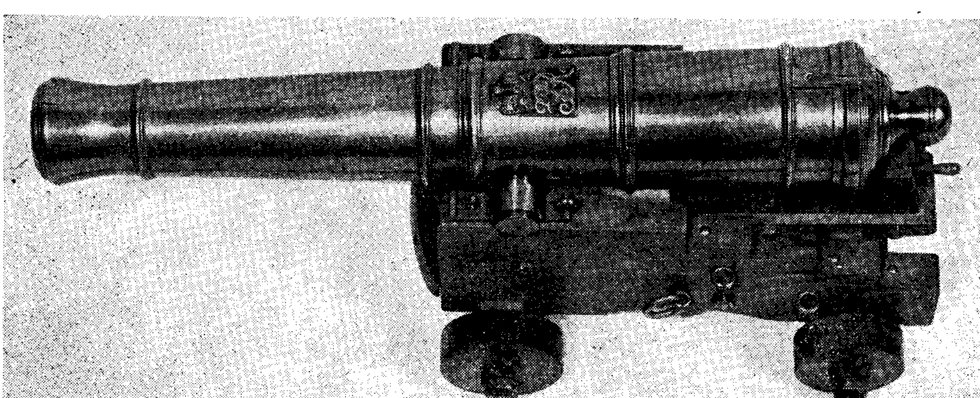
"When the barrel was completely turned and bored it was taken to my friend, Mr. Avery B. Leonard, reputedly the best engraver in Boston. He started the work of engraving and about that time I was called to active duty with the army.

"During the war, Mr. Leonard passed away, and the cannon was consigned to a vault in the basement of the Ritz-Carlton Hotel Building, where Mr. Leonard had his offices.

"You may be sure that after my 'four years and three days' the first thought on coming home was to rescue the cannon, and hunt up a successor to Mr. Leonard. After several attempts I was fortunate enough to have Mr. Frederick Bagshaw of Malden offer his services. He is quite famous for his sculpture work, and he makes most of the bronze tablets about Boston, particularly that on Paul Revere's house and the old North Church.

"Anyone interested can find an account of this cannon in *Memories of Artillery* (in French), by Le St. Surirey de Saint Remy, published at Amsterdam, MDCCII.

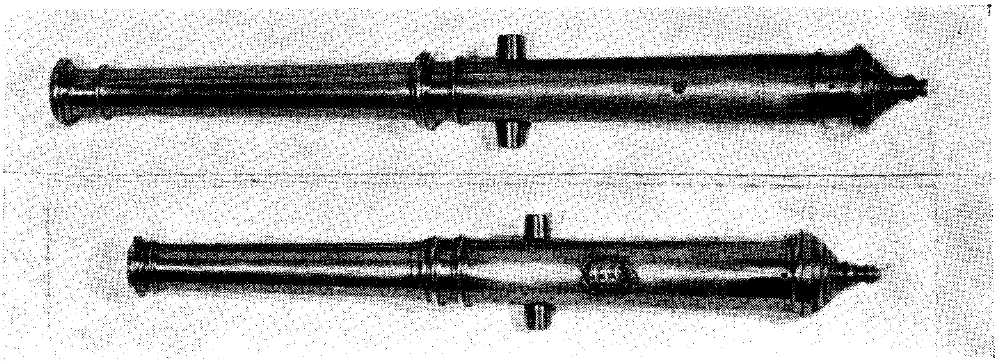
"The other three cannons recall a bit of English



history. The large model is part of the original armament of the United States frigate *Constitution*. It is known that 18 of her original 24-pounder gun-deck guns were purchased in England. These guns bear the date 1798, a crown and 'G.R.' They are marked with the broad arrow. The model shown has a

"The smaller is a 'sakeret,' of the time of Edward VI, 1547, with a shield and three lions *passant*, and is inscribed: 'Tomas owen made this pese, for the ye'l of Garnse vhan ser Peter Mertas vas governor and captayn, Anno Dni, 1550.'

"I had better explain that the 'ye'l of Garnse'



barrel length of 15¾ in. The engraving of all three was done by Mr. Avery B. Leonard, many years ago.

"The mounted model is made to scale from plans drawn up in the Boston navy yard during the 1927-1931 restoration. The type of 24-pounder guns as carried by the *Constitution* during the years 1812-1814, has been a subject of exhaustive research.

"The two small pieces were constructed from scale measurements of the originals, which are now part of a memorial on Burial Hill, Plymouth, Massachusetts.

"When the writer was a boy scout, in 1920, he participated in the ceremony at the tercentenary, when these two cannon were presented to the town of Plymouth, by the people of Plymouth, England.

"The longer of the two is 'Minion' of the time of Mary, 1554, with a rose and the letters M.R., and is inscribed 'John and Thomas Mayo, bretheren, made this piece, Anno Dni, 1554.'

meant the island of Guernsey, in the English Channel.

"In 1937 I wrote to Charles Ffoulkes, Master of the Armouries, H.M. Tower of London, in regard to suitable carriages, on which to mount these pieces. Since the rough woodcuts in early sixteenth-century gunnery books were not clear enough to make an authentic carriage, it was decided to leave them unmounted.

"Mr. Ffoulkes wrote that these pieces were formerly at Woolwich, for he copied the inscriptions there some years before."

Mr. Ogden tells us that he is a designer in a factory, producing ultra short-wave cooking apparatus, which performs such culinary miracles as cooking a 10 oz. steak in 40 sec., an 8-oz. halibut in 45 sec. and a fried egg in 12 sec.

He also sent us pictures of his workshop, showing a range of equipment and plant which would make the average model engineer stare in astonishment. He has now commenced the construction of a model of a N.Y.C. Pacific locomotive.

For the Bookshelf

Practical Workshop Mathematics. By Professor C. A. Felker. (London: Odhams Press, Ltd.) Price 9s. 6d., postage 6d.

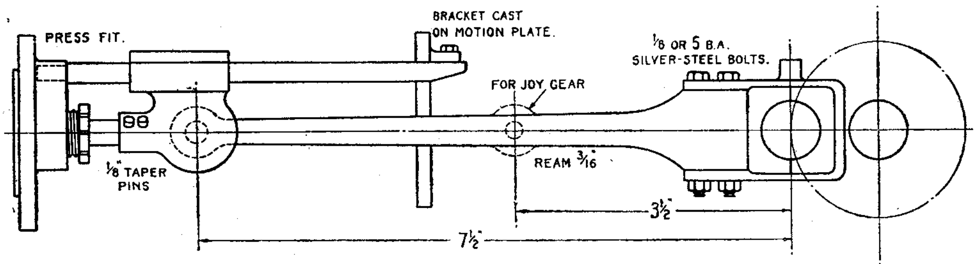
Among readers of these pages, opinions are sharply divided as to the value of mathematics in engineering, and for this reason the statement made on the inside flyleaf of the jacket—"Practically every operation in the workshop necessitates calculations"—may be questioned. The "purely practical" reader may say that mathematics are unnecessary, or even useless, in model engineering, while the "theoretical" school of thought will hold that they are indispensable. The fact is that both extremes of thought are wrong; mathematics is just a mode of expression, an extension of language which can be used to interpret engineering problems in similar manner to a blue print, and moreover, can be utilised as a means of saving time and labour, and ensuring certainty of results, in practical work. It is, however, most essential that theory and practice should be used to assist each other rather than as rival methods, and in this book, the practical application of theoretical principles and mathematical rules is carefully emphasised. Examples of calculations in measuring instruments, screwcutting, belt drives, gears, angles and tapers, etc. all illustrate the close contact between theory and practice, and the book concludes with a chapter on the slide rule, useful tables, and a glossary of shop terms.

Guide-Bars and Crossheads for "Minx"

by "L.B.S.C."

IT is just too bad that we can't use the same arrangement of guide-bars and crossheads for both the passenger and goods engines; but little things like that have to be taken into account when scheming out details of small locomotives intended for real work. However, "needs must as the devil drives," says the old saw; and it isn't such a difficult job to arrange matters satisfactorily, despite the proximity of the leading hornblocks and the leading coupled slide. The actual machining would be the same as end-milling out axlebox grooves. The groove for the guide-bar could be made in similar fashion. Care should be taken to see that the ¼-in. hole for the wrist pin goes through square with the jaw opening. I used bronze crossheads both for "Grosvenor," and for the outside cylinders on "Jeanie Deans," and they are both O.K. in every way.

If steel crossheads are preferred, build them



Crosshead and connecting-rod for the "Minx"

axle. "Petrolea," her sisters of similar class, other Great Eastern engines, Bill Adams's lovelies on the South Western, and various other well-known locomotives of past generations, managed to do the doings with a single guide-bar and a box crosshead for each cylinder, and there is no earthly reason why the "Minx" shouldn't do the same. Personally, I'd rather have this style of guide-bar and crosshead, than the type fitted to the L.N.E.R. Pacifics, which looks far less substantial; however, that is just a matter of taste, and I've never heard of any of the L.N.E.R. engines having trouble in that direction.

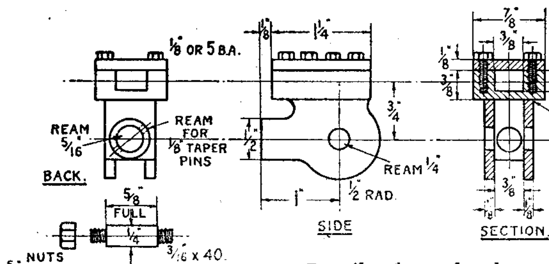
All that you need for guide-bars on the "Minx" are two pieces of steel bar of ⅜-in. by ¼-in. section, and 5⅝ in. long. Chuck truly in the four-jaw, turn the end to 7/32 in. diameter for ⅜ in. length, and file a bevel at the opposite end as shown. Press into the holes in the gland bosses, with the bevel facing toward the piston-rods. When the motion is erected, the outer ends of the bars will be held in position by being screwed to a lug or bracket cast on the motion-plate, as shown in the illustration. Details of the motion-plate will be given later.

The crossheads could be made from bronze castings, should any of our advertisers go to the trouble of providing them, as a bronze slipper or shoe works very well on a steel bar, and the crossheads are not very conspicuous, being inside the frames and outside the range of vision of friends and relatives of Inspector Meticulous. In that case, very little machining would be required. The jaw for the little end of the connecting-rod could be cleaned out with an end-mill or slot-drill held in the three-jaw, the casting being held either under the lathe tool-holder, or else in a machine-vice on a vertical up in three pieces—crosshead proper, shoe, and cover; it is the easiest way, and perfectly satisfactory. You'll need a piece of steel bar, ⅝-in. by 1-in. section, and about 3¼ in. long. Chuck this truly in the four-jaw, face the end, and turn down about ⅜ in. length to ½ in. diameter, with a round-nose tool. Reverse in chuck, and repeat operations. You can, if you like, centre and drill down ½ in. depth with letter *N*, or 19/64-in. drill, as a preliminary for the piston-rod; this hole is reamed to correct size when fitting the crossheads later on. At 1 in. from each end, on the centre-line of the wide side, drill a hole with letter *C* or 15/64-in. drill, for the crosshead pin; this also can be reamed to correct size later on, after the jaw opening has been milled. Beginners are much more likely to get a hole true and square with the sides by drilling "from the solid," than by drilling after the jaw opening has been milled out, as the drill invariably tries to wander, when doing the second side. The piece can now be sawn in half.

The next stage is to mill the jaws, and this can easily be done by the method used for the axlebox grooves. Either clamp the embryo crosshead on its side in the slide-rest tool-holder, and traverse it across a ⅜-in. end-mill or slot-drill held in the chuck, or else grip it in a machine-vice (either regular or improvised, as described some time ago) on the lathe saddle or boring table, and run it under a ⅜-in. side-and-face cutter of the ordinary milling type, mounted on an arbor between centres. Lucky owners of milling-machines won't need any special instructions for doing a simple job like that! Don't forget, whether doing this operation on either lathe or milling-machine, that plenty of cutting-

oil is needed to get a good finish. If the oil is skimped, the cutter will probably tear the surface of the steel, and by the time it is filed smooth, the jaws will be too wide. After milling the jaws, file to the given outline, leaving the top flat, for attaching the shoe or slipper.

A piece of $\frac{7}{8}$-in. by $\frac{3}{8}$-in. steel bar approximately 3 in. long, will make both shoes. Square off the ends in the four-jaw, and then mill a groove $\frac{3}{8}$ in. wide and $\frac{1}{4}$ in. deep, right down the centre of one of the wide sides, by one of the methods given above. This groove is shown in the back view and section; and if a guide-bar is placed in it, same should slide easily back and forth without any shake. It must not be tight; a weeny bit of side-play won't hurt, as long as the shoe isn't slack on the bar. Saw the piece in half, rechuck each part, and square off the sawn end so that each shoe is $1\frac{1}{4}$ in. long.



Details of crosshead

The next item is to braze the shoes to the crossheads, and this job will be a good test of your skill in doing a neat bit of work. It is perfectly easy. Tie the crosshead and shoe in position with a bit of thin iron binding wire; it is an advantage to smear a little wet flux over the contact faces, but don't overdo it, otherwise the parts will shift when the heat is applied. Be sure the crosshead and shoe are exactly in line. Lay the assembly in the coke in your brazing-pan, heat to bright red, touch the joint between crosshead and shoe with a bit of 16-gauge soft brass wire, or a bit of $\frac{1}{16}$-in. Sifbronze rod, and if the heat is sufficient, it will immediately melt and flow through the joint. Very little is needed. Let cool to black, quench in clean, cold water (not acid pickle for steel, beginners should recollect) and clean up. If you don't have to touch the result with a file, take full marks; but if any blobs of brass are showing at the joint each side, file them off carefully.

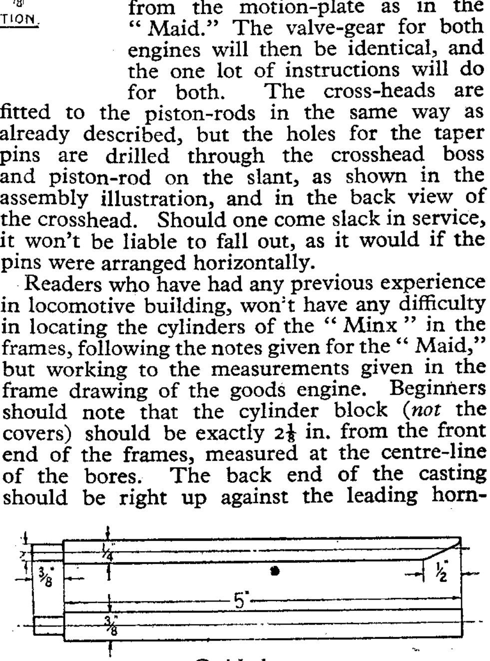
All we need now, is a cover-plate, and this is merely a piece of $\frac{1}{8}$-in. by $\frac{7}{8}$-in. flat steel a full $1\frac{1}{4}$ in. long, for each crosshead. At $\frac{1}{8}$ in. from the edge at each side, drill four No. 30 holes, as indicated by the screwheads in the illustration. Next, file off any burrs, temporarily clamp each cover on its crosshead, run the 30 drill through the holes, making countersinks on each "side wall," drill them No. 40, tap $\frac{1}{8}$ in. or 5-B.A., and put screws in to correspond. I have shown hexagon heads just to please the old inspector, but really any heads will do, quite as well. Finally, file the ends of each cover-plate flush with the ends of the slipper.

The crosshead-pins are pieces of $\frac{1}{4}$-in. round silver-steel a full 1 in. long; chuck in three-jaw, and turn down $\frac{3}{16}$ in. of each end to $\frac{3}{16}$ in. diameter, screwing $\frac{3}{16}$ in. by 40. The centre part should be a weeny shade over $\frac{5}{8}$ in. long, so that when both nuts are screwed up tightly, the pin won't squeeze in the sides of the crosshead. Ream out the holes in the jaws, so that the pins fit exactly; they don't have to turn, as the little-ends should be a nice working fit on them.

Connecting-rods

The only difference between the connecting-rods for the "Maid" and the "Minx," is that the latter are $7\frac{1}{2}$ in. between centres, slightly longer than those for the "Maid." The construction is exactly the same. If you are going to fit Joy valve-gear, make the boss for the jack-link pinhole at 4 in. from the little-end, so that it will be the same distance from the motion-plate as in the "Maid." The valve-gear for both engines will then be identical, and the one lot of instructions will do for both. The cross-heads are fitted to the piston-rods in the same way as already described, but the holes for the taper pins are drilled through the crosshead boss and piston-rod on the slant, as shown in the assembly illustration, and in the back view of the crosshead. Should one come slack in service, it won't be liable to fall out, as it would if the pins were arranged horizontally.

Readers who have had any previous experience in locomotive building, won't have any difficulty in locating the cylinders of the "Minx" in the frames, following the notes given for the "Maid," but working to the measurements given in the frame drawing of the goods engine. Beginners should note that the cylinder block (*not* the covers) should be exactly $2\frac{1}{8}$ in. from the front end of the frames, measured at the centre-line of the bores. The back end of the casting should be right up against the leading horn-



Guide-bars

blocks. If the cylinders are too far forward, either file or saw away a little of the hornblock flange until the cylinders can be set in correct position. I have never had the slightest trouble in trimming up hornblocks in position, by using a broken bit of hacksaw blade fixed in a handle, like a keyhole saw. With this simple gadget, you can cut off the corner of a hornblock casting quite easily, and with a little care, it can be done without even marking the frame. The cylinders are inclined much more than those on the "Maid," as the piston-rods and crossheads have to clear the leading axle. The front end of the steam-chest (not the cover) will project approximately $\frac{1}{4}$ in. above the top of frames;

and at the back end, it will be $\frac{1}{8}$-in. below, the top of the cover just showing. The projecting part of the steam-chest will be covered by the smokebox saddle on the finished engine.

The next item is the valve-gear, but before going into details of that, I will give the alternative arrangement of outside cylinders for the "Maid of Kent," as promised earlier. Outside cylinders are not suitable for the "Minx," as the frames would have to be lengthened to accommodate them. Anybody wanting an outside-cylinder 0-6-0 should obtain the blueprints of "Iris," and use the chassis with all dimensions enlarged in the proportion of 7 to 10. The boiler of the "Minx" can easily be adapted to suit. Mention of blueprints reminds me that at time of writing, Mr. Roy Donaldson, the Southern draughtsman, is busy making proper tracings from my original drawings of the "Maid" and the "Minx," making certain details correspond to full-size practice; and by the time these notes appear, prints full-size for 5-in. gauge should be available from some of our advertisers. This will answer several queries recently received on this subject.

A really massive job by D. W. Massie

"Something Bigger"

Mr. D. W. Massie, of Montreal, has a letter missing from his name. There should be a "v" between the last two letters; judging by the size of the 4-8-4 locomotive illustrated, and the articulated engine which he is at present building, he certainly bears relationship to Bill of that ilk! I have no detailed information about the engine shown, except that it is 7 ft. long, but it is certainly a worker, for at the Montreal "meet" last September, it ran fifty miles in the two days, driven by Mr. J. Bedbrooke, shown in the picture. He and his passenger, Mr. F. Whitcombe, are both officials of the Canadian Car and Foundry Co., so they should be good judges of what constitutes a good load for any engine. The wooden handle projecting from the opening between engine and tender, shouldn't be there, by the good rights. It is the removable extension handle of the emergency hand pump; Mr. Massie likes it better than the usual metal lever. Our friend has promised a photo and details of the articulated engine, and from what I gather, she will be something bigger still!

The photograph also shows the construction of the new Montreal club line, which is 800 ft. long, and goes around the outside of the old original one. The rails are made from iron bars of 1-in. by $\frac{1}{4}$-in. section, bolted together at every 18 in. with spacers between. The longitudinals are of the usual type, but at the joints they are reinforced by iron bars 2-ft. long; one can be seen under the engine cab. Wooden guard-rails are provided to prevent the cars tipping when carrying passengers riding astride. The sections are mounted on standards made from full-size sleepers (or ties, as they are called over the "big pond") cut into 2-ft. lengths and joined as shown. The whole outfit is bolted together, creosoted, and painted, and should last many years.

PETROL ENGINE TOPICS

*A 10-c.c. Flat Twin Two-Stroke Engine

by Edgar T. Westbury

I HAVE described two forms of eccentric turning fixtures in connection with crankshaft machining ; namely, the vee-angle plate and the flanged socket type, both of which are adapted to bolt on the lathe faceplate, and to be set up to the required degree of eccentricity. The former is the simpler fitting, and more readily adaptable, but perhaps not the most suitable in the present case, though it can be used quite successfully if due care is taken. It is most essential that the journals shall both be turned to exactly the same diameter, and dead parallel, but not necessarily to finished size ; in fact, there are many advantages in having them well oversize, for better support, and also enabling any marks which may be made by clamping to be machined away afterwards.

It should hardly be necessary to observe that the main journals should be turned on perfectly true-running centres, both at this stage, and in the finishing operation, but I find the precaution of checking up on the running of the live centre is only too frequently neglected, with obvious detriment to the accuracy of the finished work. Make sure that the live centre is bedded firmly home in the socket of the mandrel—not reposing in a cosy nest of assorted swarf !—and if it is a soft centre (as it should be), it is worth while, on a special occasion like this, to treat it to a light skim up. It is a good idea to saw away the majority of the surplus metal at the crankpin end, and to face the centre of the disc, and countersink the centre hole, before taking the last cut prior to mounting the shaft for eccentric turning.

Another obvious but often neglected precaution : make certain that your angle-plate or other chucking fixture is square with the faceplate ! Recently I was profoundly shocked to find that a favourite angle-plate on which I had been relying for years was measurably out of truth—it was almost as bad as finding one had been deceived by an old and trusted friend ! In the case of a vee angle-plate, a parallel mandrel should be placed in the vee for checking up on squareness. But don't forget that all this is in vain if the faceplate is running out of truth—or if you are trying to check up by means of a " square " that isn't !

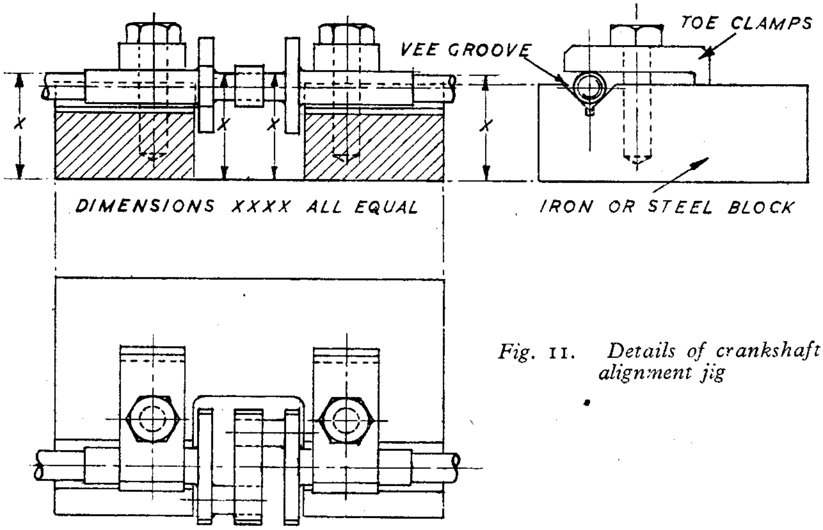
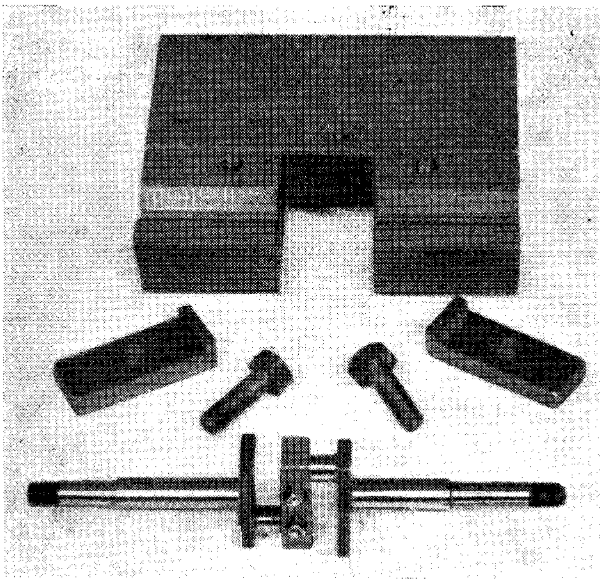


Fig. 11. *Details of crankshaft alignment jig*

A socket fixture is rather better for this particular job than a vee angle-plate, and if bored in position on the faceplate before setting to the required eccentricity, its alignment should be beyond question. It is, however, essential that the main journals should both be an exact fit in the socket and should be firmly secured in such a way that they are not forced out of truth. An ideal fixture for work of this nature would be a collet chuck mounted on a flat flange for attachment to the faceplate ; this would avoid the necessity for meticulous accuracy in the diameter or parallelism of the journals.

**Continued from page* 296, " *M.E.,*" *March* 18, 1948.



Crankshaft alignment jig with complete crankshaft assembly

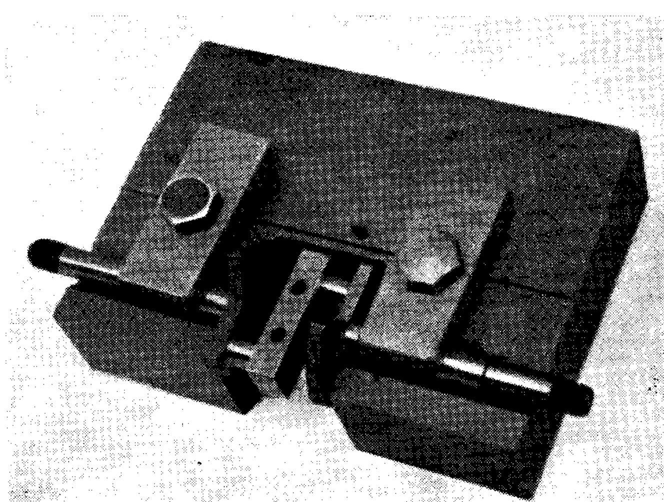
Having set up the fixtures to bring the throw centres exactly true, the crankpins may be turned and drilled through the centre at one setting, taking great care to obtain accuracy and high finish, also true parallelism along the full length of the pin, although only half of it is to be the bearing surface for the big-end. In the event of intending to case-harden the shaft—which is certainly desirable to avoid heavy wear and reduce friction—some means should be adopted to prevent hardening of the clamped end of the pin. The usual shop method of doing this would be first to machine the bearing part of the pin to diameter plus finishing (grinding ?) allowance, leaving the clamping part oversize by more than the carburising or " case " depth. After carburising, but before quenching, the pin is re-chucked and turned down to match the bearing diameter, after which it is re-heated, quenched and finished.

This procedure is somewhat complicated for the amateur worker, and a fairly satisfactory alternative is to use a good quality steel which can be machined and left in the unhardened condition. If desired, the bearing surfaces of a mild or low alloy steel shaft can be hard-surfaced by a thin layer of hard chromium, applied by electro-deposition.

It is, of course, important that the two shafts must be identical in throw dimensions, so the turning fixture must not be shifted between operations—but do not dismount it after both are completed, as it will be wanted again.

The centre web should be made from material thick enough to allow of machining the side faces, to ensure their exact parallelism and truth with the bore of the eyes. The positions of the three holes should be marked out on the face as accurately as possible, keeping them exactly in the centre of the material and truly in line. Drill small pilot-holes at least partly through the material to preserve the location of the centres when the bar is faced ; then set it up in the four-jaw chuck to centralise the middle hole, which is drilled dead truly and bored or reamered, after which a facing cut is taken right across the front surface. Reverse the bar, holding it on a pin mandrel to face the other side, and check it for parallelism all over before proceeding further. The outer ends may also be machined to $1\frac{1}{8}$ in. diameter at this setting.

A mandrel is now made, having a main diameter exactly the same as that of the main crankshaft journals, in the condition as machined for eccentric mounting, and turned down at the end to take the centre bore of the web a stiff push-fit, with a thread at the end for a securing nut. The web is mounted on this mandrel and held in the eccentric turning fixture in the same way as the half-cranks ; it will be clear that if either of the located centres at the ends of the web are brought into position, and bored out, they will be exactly the same throw as the crankpins. It may be that these centres will not set up dead truly, due to slight errors in marking out or pilot drilling ; if so, concentrate on getting them as true as possible *sideways*—do not shift the eccentric fixture on

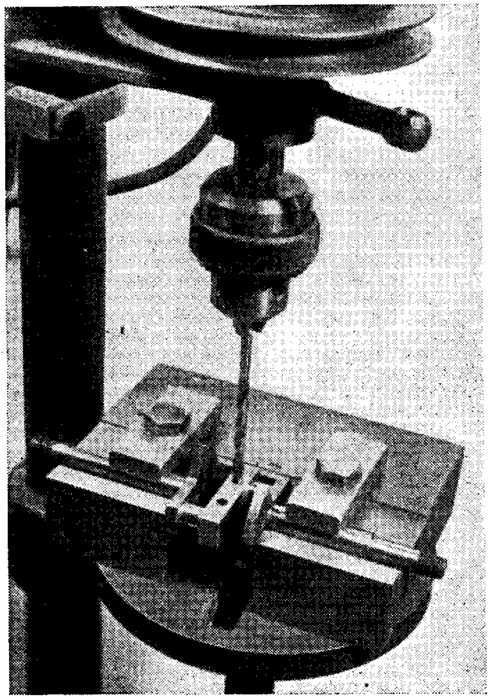


Crankshaft alignment jig with crankshaft assembly in position

any account. Bore out each of the eyes in turn to a really good wringing fit on the crankpins. If the edges of the web are not already finished to size, they may be machined, to ensure that the eyes are kept central with the width.

Crankshaft Alignment Jig

To those readers who are apt to exclaim with horror, "What—another of those beastly mass-production jigs for a one-off job?"—I would remark that it is possible to do the rest of the work on the crankshaft without one, but it will be much easier, and reduce or practically eliminate risk of error, if one is used. The work involved in making a jig is fully justified if it simplifies the work and ensures positive



Drilling the bolt holes in centre web of crankshaft

accuracy, as a well-designed jig should. In this case the construction of the jig is comparatively simple, and it is applicable, with possibly a little modification, to other common workshop problems, so that the time spent on making it will certainly not be wasted.

A drawing of the jig, with the crankshaft assembly in it ready for drilling, is given in Fig. 11, but its form and outer dimensions may be varied to suit available material, so there is no need to give exact details. Any available block of steel or cast-iron may be used, or a built-up construction may be adopted if the necessary truth and rigidity can be assured. The essential feature is the long, straight vee groove, interrupted by a gap only just sufficiently wide to admit the crank webs; the full length of the jig should not be less than 3 in. and preferably rather more. It should be possible to mill this groove in the lathe, using a slotting saw to cut out the centre and provide clearance, after which a 90 deg. vee cutter, or a double-ended fly-cutter on a boring bar, may be used to finish it. Filing and scraping may be necessary to ensure accuracy, and a straight piece of square steel bar, smeared with marking colour, may be used to test alignment. Finally, roll a straight piece of $\frac{5}{16}$ in. silver-steel, also with marking, in the groove to check contact over the full length. Then clamp the bar in the groove with the ends projecting and measure their height from the base to ensure that this is the same at both ends.

The journals of the half-cranks are, of course, finished to size before assembly in the jig, and the centre web is wrung on to locate the throws at 180 deg. Before tightening the clamps, measure the height over the crankpins and the reduced journal ends at the positions XXXX to ensure that they are all equal. The jig should be laid on a surface plate for this check, and either a scribing block used, with the bent point on top of the work, or inside callipers used to measure the space underneath. If this precaution is observed, it will ensure that the throws are exactly at 180 deg. to each other; a slight error in this respect will put the cranks slightly out of timing, not necessarily a serious matter, but will not affect alignment.

The centre web may now be drilled to take the clamping bolts, which are a tight dowel fit in the web, and as will be seen, intersect and cut into the inner side of the crankpin so as to form locating keys. Assuming that the bolts are to be 6-B.A., the finished holes should be made with a No. 34 drill, but it is advisable to use about a No. 36 drill first as a pilot. The use of a "toolmakers' reamer" (made by filing the end of a piece of 7/64-in. silver-steel away at an acute angle, like a hypodermic needle, and hardening) is recommended to ensure a true hole. Mark the ends of the web to indicate to which crankpin they belong.

An alternative to securing the shafts by split clamps would be to use carefully fitted taper pins, with draw nuts on the small end like a cycle crank cotter, but the grip of a good split clamp is considered more effective. There are, however, split clamps and split clamps; we have all seen these fittings distorted out of all recognition in the futile endeavour to pull them up tight, but this only occurs in cases when they are too flimsy for the duty required of them, or a very poor fit in the first place. The essential quality for success in a split clamping device is that it should be fitted so closely that only a microscopic amount of distortion is necessary to make it grip; and it should not be difficult to ensure this condition if due care is taken.

The slot in the centre web is cut after the bolts have been fitted, and the operation may be carried out by means of a small diameter circular slitting saw, fed into the centre of the web, the latter being clamped to a vertical slide or angle-plate; in the latter case it must be disposed vertically to avoid the need for vertical adjustment. In the absence of any means for carrying out this

(Continued on next page)

SOLDERING ALUMINIUM

by J. R. Bryant, B.Sc.

MANY engineers believe that it is impossible to solder aluminium. This is certainly true if by "soldering" one means the use of ordinary solders, soldering fluxes and technique; but by using a special solder, in conjunction with a special technique, excellent joints can be made. The technique is easily acquired and a suitable solder can be prepared from easily-obtainable materials.

In soldering any metal, it is essential to remove the oxide films which are invariably present, both on the metal to be soldered and on the molten solder, to permit intimate contact of the two metals so that union can occur. This can be accomplished readily, in the case of most metals, by using a flux which dissolves the metallic oxides as rapidly as they are formed.

Unfortunately, so far as the writer is aware, there is no flux available which will dissolve the oxide of aluminium at the ordinary temperatures used in soft-soldering. One alternative is to use a mechanical method of cleaning the aluminium. Thus it is possible to cause ordinary tinman's solder to adhere to aluminium by scratching the surface of the aluminium, beneath a blob of molten solder, by means of a broken hacksaw blade. The process is however tedious and uncertain because, although the aluminium can be cleaned in this way, no amount of scratching will remove the oxide film from the blob of molten solder.

The literature of soldering contains innumerable references to solders specially devised for soldering aluminium. Most of these solders contain considerable proportions of zinc. Now zinc has the useful property of being able to alloy with aluminium notwithstanding the film of oxide on the latter metal. Used by itself it has however two disadvantages. First, the temperature required to melt the zinc is much higher than in ordinary soldering; and, secondly, the attack produced on the aluminium by the molten zinc tends to be excessive. These difficulties are obviated by diluting the zinc with other metals. The simplest and best of several solders tried by the writer contains 60 per cent. of tin and 40 per cent. of zinc, but excellent results can be obtained by using tinman's solder instead of tin.

Small quantities of solder can be made by melting together 60 parts of tinman's solder and 40 parts of zinc in a suitable container, e.g. a tin lid, and pouring into sticks. A piece of angle iron, slightly tilted, forms an excellent mould; but failing this, quite presentable sticks may be made, with a little practice, by pouring the molten metal on to a concrete floor, moving the container at the same time horizontally at an appropriate rate.

The surface to be soldered is first cleaned with emery paper. Heat is then applied, preferably to the reverse side of the article, until the work is sufficiently hot. The tip of the stick of solder is then rubbed firmly on the surface to be tinned. If the work is too cold, blobs of solder may form which will not however adhere to the aluminium. They should be removed. When the correct temperature has been obtained, the solder will adhere immediately wherever the stick has been rubbed on the surface; but not elsewhere.

Using this technique alone, it is possible to effect simple repairs to aluminium articles. For example, one can build up a fillet of the solder round the base of the spout of a leaky aluminium kettle, or repair a hole in a saucepan; but the technique must be modified to deal with more complicated work, as follows.

Aluminium may be tinned using the special solder described. The "tinned" surface may again be tinned using ordinary tinman's solder and killed spirits as a flux. With this slight modification in technique, it is possible to execute all the usual soldering joints and to make joints between aluminium and other metals, both with the blowpipe and with the soldering iron.

The two main objections to soldering aluminium are first, that the technique required is more difficult and tedious, and secondly, that the joints made are particularly liable to corrosion. Provided, however, that the joints are not exposed to unduly corrosive conditions, excellent results can be obtained.

In conclusion, it should be noted that there is at least one excellent aluminium solder on the market.

Petrol Engine Topics

(Continued from previous page)

work, the use of a small hand sawing tool, such as the Eclipse 4S or the Enox, may be resorted to.

Ordinary commercial quality bolts are not reliable for clamping the web, and special bolts of high tensile steel should be made, with plain shanks to fit closely in the holes. Special nuts, of greater length than normal, may be made from the same material, and fitted somewhat tightly to the threads. Allen type set-screws have been tried for this job, but although they provide the requisite strength, the shanks, which were screwed all the way, were not effective as keys.

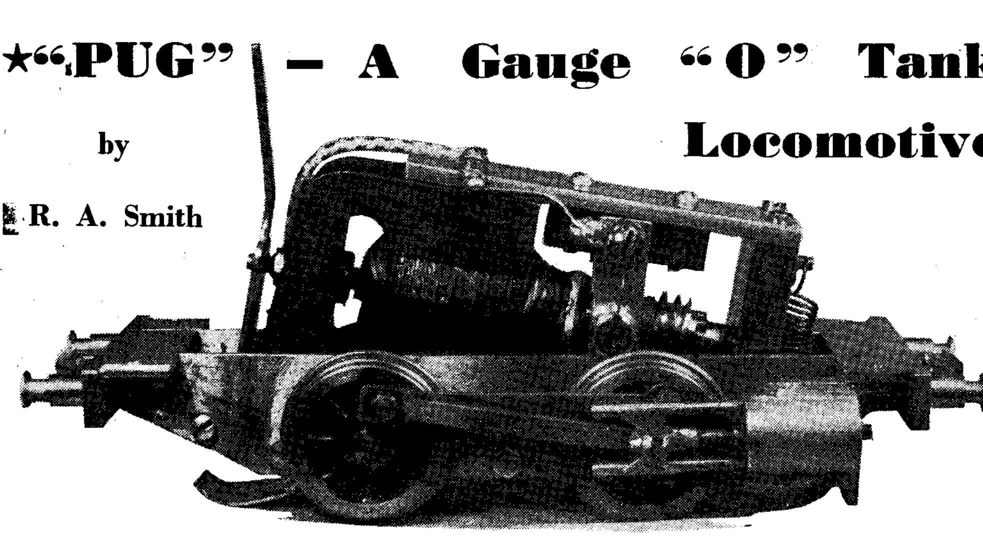
Final assembly of the crankshaft, after the connecting-rods have been threaded on the crankpins, should also be carried out with the journals clamped in the jig, and in this way there should be no question as to their true alignment.

(To be continued)

*"PUG" — A Gauge "O" Tank Locomotive

by

R. A. Smith



BRUSHES have been tried of brass, copper and phosphor-bronze strip; also of brass and copper gauze, in the hope that this part of the job could be simplified; but none of these was found really satisfactory, and it was eventually decided that carbon brushes were well worth the time and trouble involved. A block of ebonite (fibre would have done as well) was cut and attached to the under-side of the brass strip which carries the "outside" bearing, and to the sides of this were attached the brush-holders. These were formed from $\frac{3}{8}$-in. × $\frac{1}{8}$-in. brass strip. Each had a 4-B.A. clearance hole at one end and, in correct position near the other end, a $\frac{1}{4}$-in. hole was drilled to take a piece of $\frac{1}{4}$-in. o.d. brass tube about $\frac{5}{16}$ in. long. These tubes, which carry the brushes themselves, were soldered in, and so positioned that the brushes came exactly opposite the centre of the armature spindle.

The brushes were made from a brush taken from a defunct cleaner-motor. They are each about $\frac{3}{8}$ in. long and filed to a circular section of such a diameter that they will slide freely (no shake !) in the tubes. One end of each was slightly hollowed to fit the curve of the commutator and a shallow groove filed across the other end. This groove was to take the end of a piece of 30-gauge spring-steel wire which was anchored at its other end under the 4-B.A. screw which holds the brush-holder to the ebonite block. The tension provided by this piece of wire was found ample to provide the required slight pressure on the end of the brush.

Soldering-tags were placed under the screws before finally tightening, in order that connections could be made conveniently when the time came. The motor unit was eventually passed as being satisfactory and attention given to the locomotive itself. Sketch, Fig. 6, shows the brush gear.

A search was made through recent volumes of THE MODEL ENGINEER for a likely outline, and a drawing of an 0-4-0 dockland tank engine was found in one of "L.B.S.C.'s" articles. This was slightly altered, to provide side tanks instead of a saddle tank and drawings were made, always with the motor unit well in mind. The design provided for $1\frac{1}{4}$ in. drivers, and castings were ordered for these. Meanwhile, frames (of $\frac{7}{8}$-in. × $\frac{1}{16}$-in. mild-steel) and buffer beams (of "windscreen" brass angle) were made and erected. Then a blow ! It was found that the only castings available would machine to $1\frac{1}{8}$ in. diameter, and, as it was too late to redesign the whole thing, these had to be used. It meant, of course, that the whole "doings" would be pitched lower, but the final appearance wasn't bad and, as it was intended to make the rolling-stock as well, it was not thought important.

An unsuspected snag did develop as a result though. The amount of space available for collectors—already on the small side—had now become even smaller. To ease the situation here, it was then decided to use the "all level" track system and there now seemed to be plenty of room to fit proper "spoon" type sprung collectors. Small ebonite blocks were fitted between the frames to which these were later attached. Wheels and axles (the latter $\frac{1}{4}$ in. in diameter and running in plain holes drilled in the frames) were turned and crankpins of 5/32 in. diameter steel fitted into holes tapped 4-B.A. in the wheel bosses. The rear crank-pins were made longer by $\frac{1}{16}$ in. to accommodate connecting-rods, as it was intended to fit a pair of dummy outside cylinders. Wheels were "quartered" and pressed home (not forgetting the worm-wheel on the leading axle) and coupling-rods made of $\frac{1}{16}$-in. steel strip cut out and fitted.

The chassis now being more or less complete, attention was given to the matter of mounting the motor. Much thought was given to this, as it was desired, if possible, to incorporate some form of clutch or free-wheel device so that the future owner would be able to push the locomotive along the track (or over the polished surface of the dining room table !) and watch the "wheels go round." Readers who are parents of young boys will appreciate that this provides almost as much amusement to the youngster as running the

*Continued from page 328, "M.E.," March 25, 1948.

locomotive in the approved manner. It will be realised that worm drive is non-reversible, and, therefore, the wheels will not turn unless the motor is under power. The difficulty was satisfactorily overcome in the following manner.

Motor Fixing and "Free Wheel" Device

The motor unit is mounted between the frames and is free to swivel in a vertical plane on two trunnion-pins (of $\frac{1}{8}$-in. steel screwed 6-B.A. to suit tapped holes already provided in each side of the "lower" limb of the field-magnet) which have bearing in two holes drilled

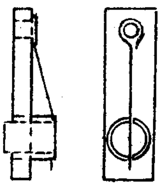


Fig. 6

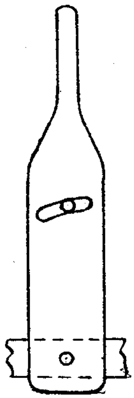


Fig. 7

and reamed $\frac{1}{8}$ in. in each of the frame-plates. The motor unit is, therefore, free to tilt upwards, thus releasing the worm from engagement with the worm wheel on the driven axle. It is normally kept with its "nose to the grindstone" by a fairly strong tension spring at the front end. One end of this spring is anchored to a small pin screwed into the outer face of the steel bearing-plate, the other to a similar pin fitted into the front ebonite "collector mount." This spring keeps the lower end of the steel bearing-plate hard up against the top face of the ebonite block and is, of course, the normal running position. In order to release the drive, a vertical lever (also of $\frac{1}{16}$-in. steel) is pivoted transversely on a piece of $\frac{1}{4}$-in. square rod fastened between the frames at the rear end of the chassis. This lever is carried upwards, narrowing towards the top, and projects through a narrow slot in the cab roof. In a suitable position (roughly half way up the lever) a "sausage" shaped slot is cut, which engages over the plain end of the thrust adjusting-screw in the rear motor-bearing. This slot is cut in such a way that, when the lever is moved over, the top edge acts as a cam and pushes the rear end of the motor unit down approximately $\frac{1}{16}$ in., which is sufficient to raise the front end about $\frac{1}{8}$ in. and throw the drive completely out of mesh. A sketch of the lever is shown in Fig. 7, and will help explain the construction.

Collectors

Two of these were made from sheet brass, as shown in Fig. 8, and screwed one to each ebonite block. They were made somewhat on the lines of the "crocodile" clips used by the wireless fans, the springs being wound from a strand of Bowden cable. The actual collector is hinged on a piece of $\frac{1}{16}$-in. wire pushed through holes drilled in the projecting and turned-up lugs formed on each side of the collector itself and the base-plate.

The whole chassis was then tested on the track and, when all was satisfactory, I settled down to the making of the "top works" and the trimmings. These were made from odds and ends of brass sheet, tube and rod and need no detailed description; lots of patience and a soldering-iron being the two main essentials. A footplate of 18-gauge material was first cut—being open in the centre to clear the motor unit, and all the rest of the upper works were built-up on this.

The footplate was edged with $\frac{1}{8}$-in. square brass along the two sides and the whole lot was secured to the chassis by four screws which pass through clearing-holes drilled at either end of each buffer beam. The two at the rear end screw into nuts soldered on to the floor of the cab, and the two in the "bows" into the bases of the headlamps which are, of course, soldered to the footplate. A pair of outside cylinders were made from $\frac{1}{2}$-in. round brass rod and slung from the underside of the front buffer-beam by little brass brackets. Guide-bars, cross-heads and connecting-rods were all fabricated from odds and ends of materials. The piston-rods slide in drilled holes in the cylinders. Spring buffers and coupling-hooks fore and aft, hand-rails, etc., completed the trimmings and the result was quite pleasing to the eye.

Owing to a present shortage of rolling stock, it is hard to give an accurate estimate of per-

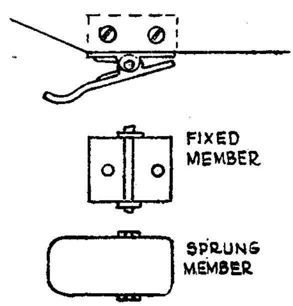


Fig. 8

formance, but it will get moving in either direction pulling a pair of trucks with a pair of "Gents' No. 9's" precariously balanced thereon. Power supply is from a rectifier unit giving 12 volts maximum with an output of up to 3 amps. The actual current consumption has not been ascertained, but a 3-amp fuse in the circuit remains intact when the locomotive is running.

Whilst on the subject of power supply, it should be noted that, for a motor of the type described, "full wave" rectification is absolutely necessary if rectified a.c. is to be used. Of course, the perfectly smooth current from an accumulator is ideal, but it will be found that a "half wave" rectifier is useless, the output being far too rough and will only result in very much sparking at the brushes and consequent burning of the commutator.

A Small Cutter Frame

by C. R. Jones

FLYCUTTERS having been in the news in THE MODEL ENGINEER of late, the writer thinks a description of a small cutter frame made some years ago might be of interest to readers. It was made for use on a 3-in. lathe, but could be adapted to suit lathes of other centre heights.

The complete cutter frame is shown in photograph No. 1 and its component parts in photograph No. 2, also in the drawing.

The main frame (A) was made from a length of $\frac{3}{8}$ in. × 1 in. flat mild-steel, heated and bent at right-angles at both ends to the dimensions shown, the ends being then rounded off and the back surface carefully filed flat. It was then laid on a flat surface and

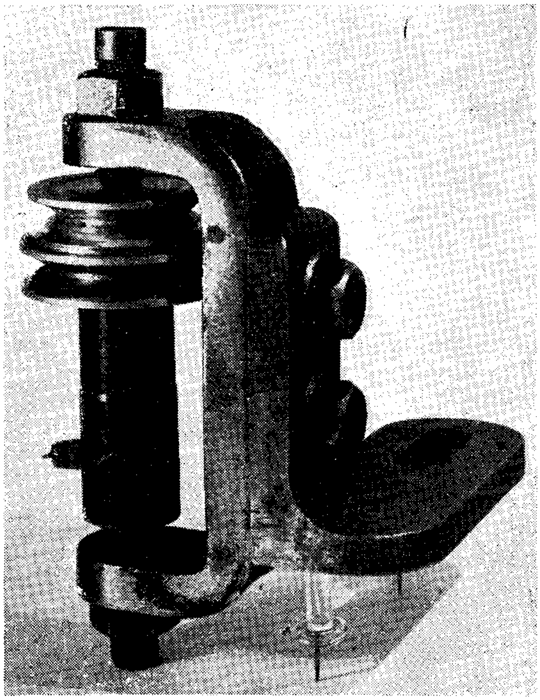


Photo No. 1. The complete frame

the positions for the conical screws marked off and small holes drilled at these points, which were afterwards opened out in the lathe to tapping size for $\frac{3}{8}$-in. B.S.F., one end being supported on the back centre to ensure both holes being in line. These holes were then tapped $\frac{3}{8}$ in. B.S.F. by the same process, holding the tap in the chuck and the other end supported as before.

To complete the frame portion a row of five holes were marked off at $\frac{7}{16}$-in. centres in the back, and these were afterwards tapped $\frac{5}{16}$ in. B.S.F. (See Fig. 1.)

The two coned screws (B) were made from $\frac{3}{8}$-in. B.S.F. mild-steel set-screws, these being carefully set

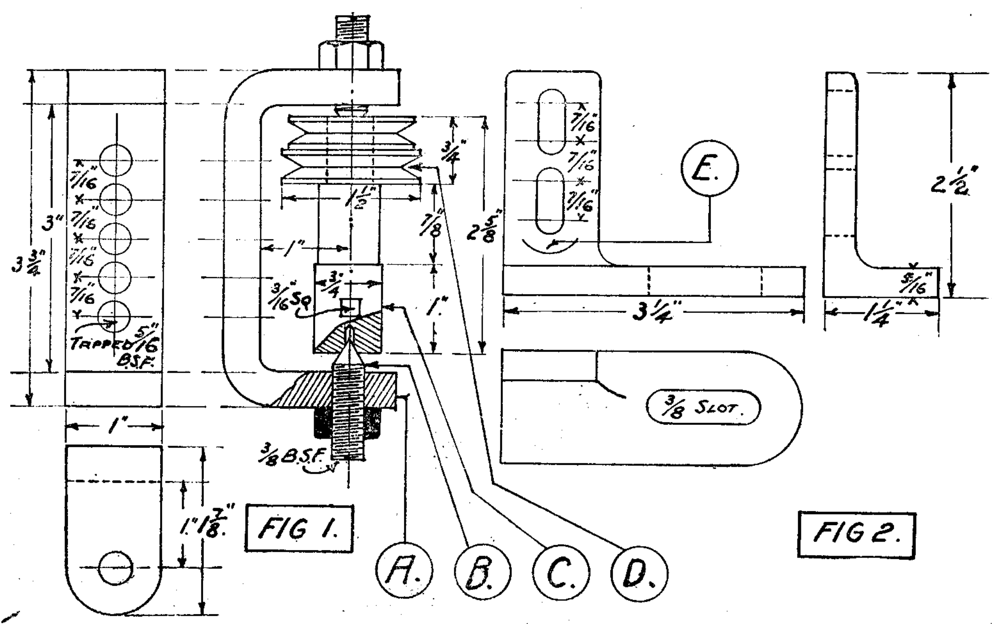


FIG 1. FIG 2.

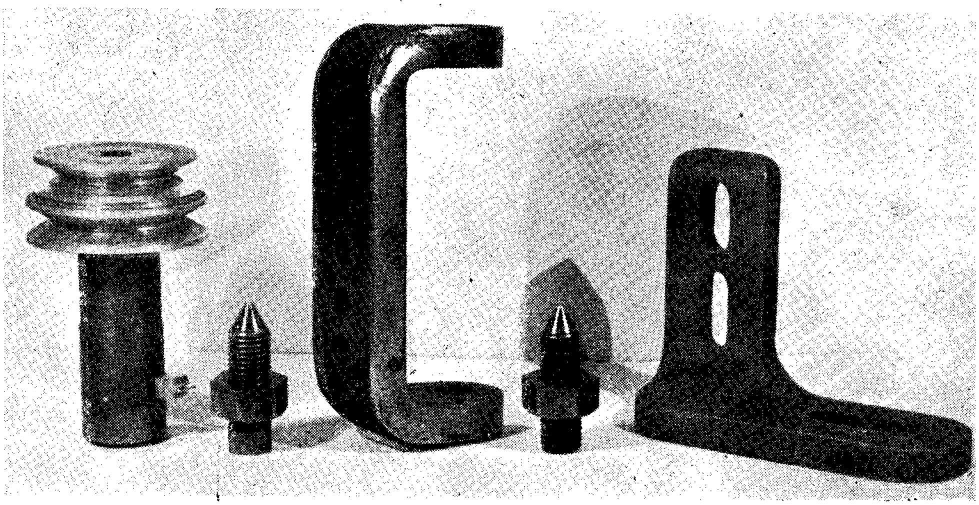


Photo No. 2. Component parts of the cutter frame

up and coned to fit a hole drilled with a Slocombe centre-drill, after which they were cut off to $1\frac{1}{8}$ in. long and provided with screwdriver slots.

The spindle (C) was made from $\frac{3}{4}$ in. diameter mild-steel, a piece being cut and faced up to $2\frac{5}{8}$ in. long, and the ends carefully and deeply centred at each end. The centre portion was slightly reduced and the top portion was turned down to $\frac{1}{2}$ in. diameter for a length of $\frac{3}{4}$ in. to accommodate pulley.

At $\frac{1}{2}$ in. from the lower end a hole was drilled diametrically, and then carefully filed and drifted to $\frac{3}{16}$ in. square to accommodate the tool, a hole being drilled at right-angles to this and tapped to take a grub-screw to secure cutter.

(*Continued on page* 359)

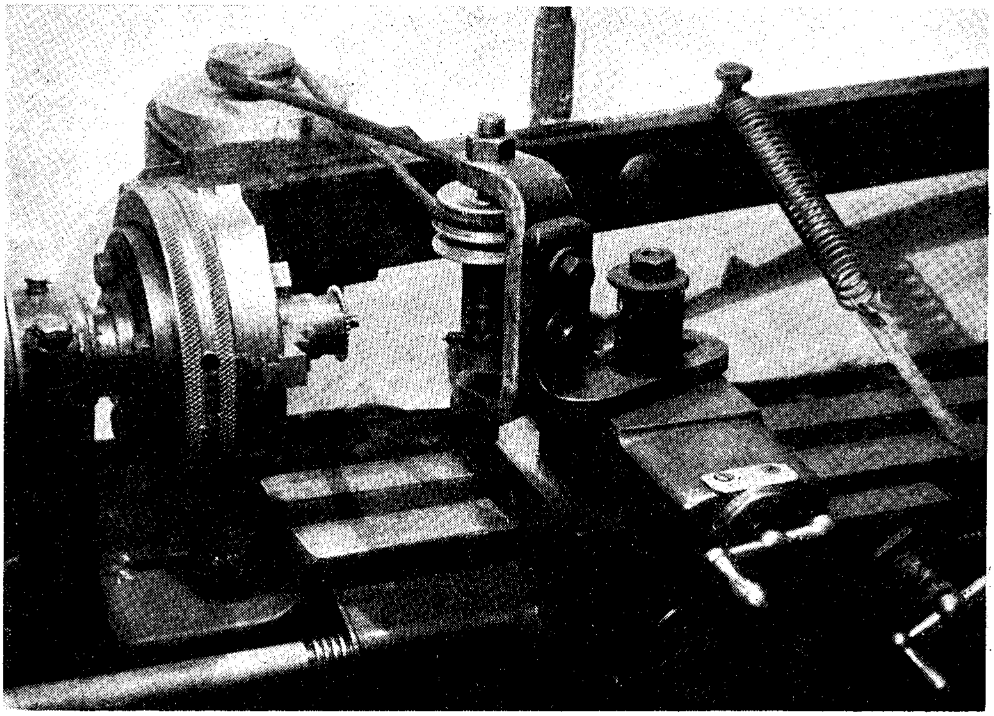
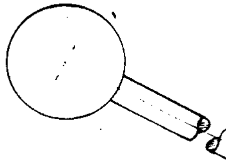
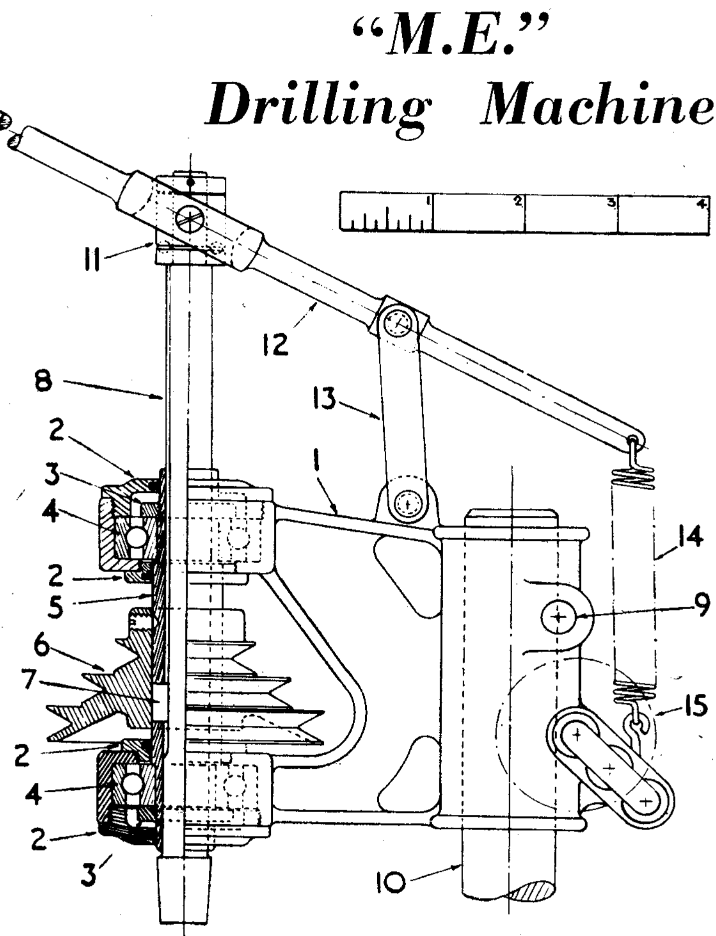
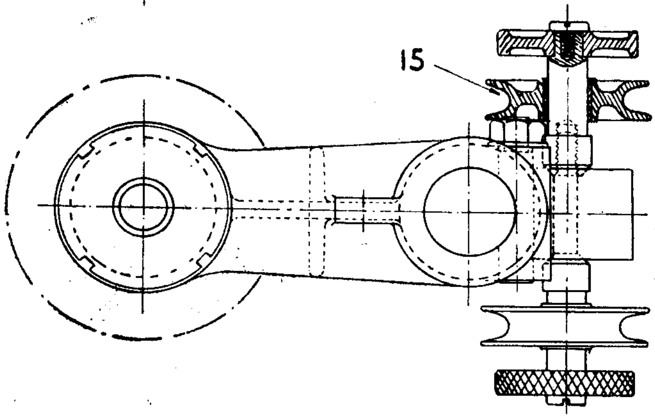


Photo No. 3. The cutter frame set up for cutting clock wheels

A Ball-Bearing Spindle for the "M.E." Drilling Machine







MR. S. W. COULTER, of Belfast, whose modified "M.E." drilling machine was described and illustrated in the issue of THE MODEL ENGINEER dated April 10th, 1947, has sent us a drawing of the headstock of this machine showing the arrangement of the ball-bearing spindle which is its salient feature. The headstock (1) is, in this case, an aluminium casting, and has integral housings of large diameter bored to take the ball-races (4), which do not fit directly on the spindle (8) but are fitted to a sleeve (5) having locking-nuts (3) at each end to hold the races in position, and to which the cone pulley (6) is rigidly attached. No endwise movement of the sleeve, therefore, takes place, but the spindle slides endwise through it, and is of the standard type, with a long keyway, to which the drive is transmitted by the key (7) in the sleeve.

It will be seen, therefore, that no side thrust due to the pull of the driving belt is imposed on the spindle itself, and guidance over the maximum length is provided by its close fit in the sleeve. No sliding movement through the ball-races is encountered, the methods of fitting and tolerances being as in normal practice. Dust covers (2), which may embody oil retainers or seals of the usual type, are fitted above and below each race. No end thrusts are taken by the races, and any standard radial single-row race is suitable. Other features of the headstock, and the rest of the machine, differ only in minor details from the design as originally laid down.

Cycle Lighting Improvements

Modifications to the lamp and dynamo circuit to improve reliability and efficiency

by Niall MacNeill

MR. WESTBURY'S description (MODEL ENGINEER, December 25th, 1947, and January 8th, 1948), of how to make a cycle-lighting dynamo, prompts me to describe some dynamo lamp and wiring improvements. Whether the dynamo be a purchased one or made in the home workshop to Mr. Westbury's excellent specification, it behoves the owner to give it a fair chance by ensuring that the lamp and wiring are also efficient.

from behind the reflector. The job can be done in a much more workmanlike way, especially if—as is usually the case—there is anything over 1⅜ in. internal clearance between the reflector and headlamp shell.

Either double- or single-contact adaptor and bulbs may be used, but with some advantage in the case of double-contact with respect to ease in making the "earth" connection by a wire conductor, as should—it is strongly recom-

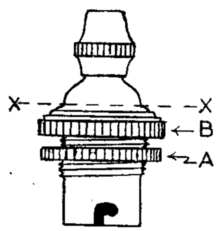


Fig. 1

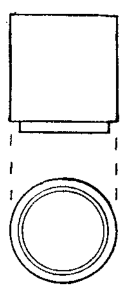


Fig. 2

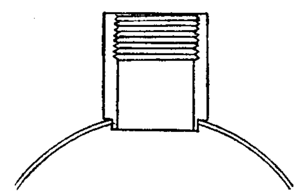


Fig. 3

Many such sets utilise Miniature Edison Screw Bulbs. These, even of the better qualities and correct nominal voltage and amperage, tend to be short-lived. It is not a difficult matter to convert a headlamp designed for the M.E.S. bulbs to take the S.B.C. (small bayonet cap) type or to adapt a cheap battery lamp in the same way. Notwithstanding that Mr. Westbury says that "series connection is the more common in cycle dynamos," many commercial sets are arranged for parallel, and—granted certain precautions—that arrangement has something in its favour. The following suggestions assume use of head and tail lamps in parallel. Also, it may be taken that they are conformable to the wattage output of Mr. Westbury's design as well as of most ordinary commercial kits.

S.B.C. bulbs rated 6 volts 3 watts, as sold for motorcar side and tail lamps, give much longer and more reliable service than M.E.S. bulbs and are—it is thought—in most localities more readily obtainable. By accurate positioning of the filament they are much superior in respect of focusing. A 6-volt 0.3 amp. bulb for the headlamp, and 6-volt 0.04 amp. for the tail, are—in the case of parallel wiring—usually recommended. The use instead of a 6-volt 3 watt (i.e. 0.5 amp.) in the headlight results in no appreciable loss in illumination, while the somewhat reduced loading of the tail bulb (in which capacity the screw-cap 0.04 kind is best retained), is all to the good in tending to prolong its life.

The writer has seen the suggested conversion crudely carried out by filing the hole in the reflector until the bayonet cap could be poked through and then loosely fitting an adaptor mended—be done. An S.B.C. lamp-holder of the type shown by Fig. 1, and which is primarily designed for indoor use of these small bulbs, lends itself more readily to the conversion than other kinds, such for instance as the double-ended variety used with an "acorn" plug. The part above *X-X* in Fig. 1 is cut off and discarded, thereby retaining just as much of the upper or back part of the assembly as will hold the insulated "inside" securely in position.

Obtain a 1 in. length of thick-walled brass tubing of ⅞ in., or just a shade less outside diameter, which should be or be bored out to 23/32 in. internal diameter. If suitable tubing is unavailable, it may be made from the solid and in any event both ends should be faced off and one end shouldered down—as shown in Fig. 2—for a length of 3/32 in. or a shade less, leaving the wall thickness of the spigot so formed not more than 1/32 in. Reverse in chuck and internally screw-cut the other end—26 t.p.i.—to a depth of ⅜ in. This may be done by hand tapping if a ¾ in. × 26 t.p.i. tap is available, but special provision will in that case have to be made to support the work, and every care taken to tap in squarely. Lathe screwcutting is on all counts to be preferred, using the lampholder as a gauge.

The hole in the reflector must now be enlarged to receive the shouldered end of the extension-piece just described, as shown in Fig. 3. The fit between the two should be exact—a somewhat tight push-fit. It has been found much more easy than was supposed to perform this operation in the lathe by chucking the reflector back outwards, using very light cuts with well-sharpened tools. The cylindrical rim of the old

hole is first faced-off and the enlargement then carried out with a keen-edged boring tool or knife-tool, ground in such a way that its flank does not foul the work. Great care is necessary as the work can only be very lightly gripped by the chuck and the least dig-in would destroy. On no account should an attempt be made to enlarge the hole as a trepanning operation.

The extension-piece is now re-chucked, taking special care to set it to run true, using packings

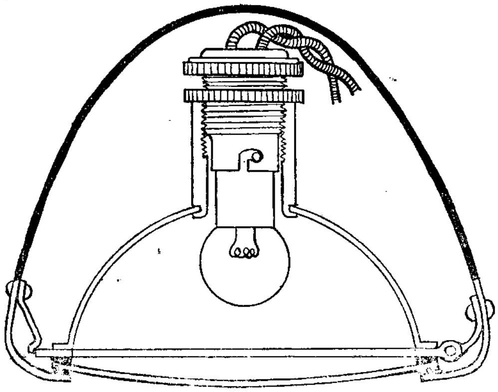


Fig. 4

if necessary. It must be firmly gripped by the chuck. The reflector is mounted on it, as shown by Fig. 3, and the shoulder spun over as shown in part-section by Fig. 4. Considerable liberties have been taken in the illustrations in combining solid and part-sectional detail with the aim of making them as explanatory as possible. The spinning can be done quite successfully with improvised equipment, with a neat finish and without any damage to the reflector if care is taken. A piece of steel rod, of ⅜ in. diam. and about 18 in. long, or any dimensions approximating these, may be made to serve as a spinning tool, by tapering and bending one end to a slight curve, and grinding the tip to spherical shape, this tip and the taper near it, especially on the convex side of the curve, being polished quite smooth. The tool-post bolt or a jury-rigged upright pin will serve as a fulcrum. The tool would probably serve a one-off job without being hardened and tempered, especially if work and tool are judiciously greased, but it will more conform to the general practice of model engineers in such cases to make a permanent job of the spinning tool when at it, including the fitting of a handle; such an addition to equipment being likely to come in useful for other purposes.

Annealing will, of course, make the spinning easier, but this again is not strictly necessary in such a light job and, if done, will entail the use of a well-fitting hard plug in the workpiece, as a precaution against crushing by the chuck jaws. To many, it will probably be found an agreeable surprise how easily a neat, secure and permanent assembly of the two parts can be done in this way. From the moment that the spinning is begun, however, and especially in the early stage, the work must be checked as it progresses to ensure that the reflector is sitting right back and square on the shoulder. It is not necessary to touch the reflector with the point of the spinning tool and, with the exercise of reasonable care, its silvered surface can be quite undamaged.

Quite good results can, however, be obtained without the use of a lathe, provided a blank of suitable external and internal diameters to serve as the extension-piece can be obtained. In that case the internal screw is tapped and the other end of the piece flat-faced by filing, the overall length being made 3/32 in. shorter, (i.e. 29/32 in.), and the assembly done by soft-soldering (but in this case a polished aluminium reflector, which are now becoming relatively common, will not suit). It is just possible, in the case of a silvered brass reflector, using a solder of low melting point and non-corrosive flux, to fix this fitting by soldering without appreciable damage to the silvering. If it suffers a little tarnishing just round the edge of the hole, this will not produce any noticeable decrease in the efficiency of the lamp in use. In any event, every trace of flux must be flushed off and a final clean-up given with chamois and jewellers' rouge.

A further-simplified method is illustrated by Fig. 5, which eliminates the need of any screw-cutting, and enables the use of a piece of tubing of about 1 in. outside diam. and whose wall thickness is not critical. In this case a second screwed ring of the type shown at *A* in Fig. 1 is required, and this is simply sweated to the inner end of the length of tubing, thereby providing the screw-mounting and focusing adjustment for the adaptor—the other ring of same kind being used as lock-nut. An incidental point in favour of this method is ample clearance for the bayonet pins of the bulb. It is less good than the other arrangements in the shallowness of the screw-mounting, entailing less rigid fixing and possibly less certain co-axial alignment of the adaptor.

These notes may suggest to the reader that, notwithstanding what has already been stated

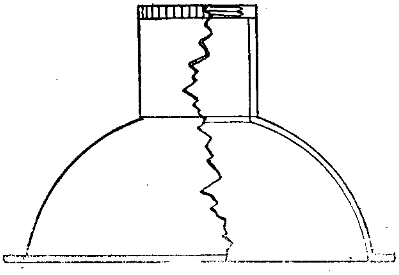


Fig. 5

to the contrary, simpler types of adaptor could be used and more easily fitted. In arriving at that conclusion, however, an important point is overlooked, namely, that the standard length of shank of these S.B.C. bulbs must be taken into account if the equipment is to be at all capable of correct focussing and that without such focussing the potential efficiency of a dynamo light, or battery light for that matter, is largely sacrificed. Nothing approaching correct focus can be had

unless the bulb can be made to sit right back into the reflector as shown in Fig. 4, and no real accuracy of focussing unless this setting is adjustable. There may be other equally efficient methods of securing this result as those recommended here, but if so they will share with the latter the characteristics of being designed for that purpose, and of requiring some little trouble in applying the design.

Except in the case of the spun-on fitting, the enlargement of the hole in the reflector is best left until after the extension is soldered on. The extension, suitably held in a vice or otherwise firmly fixed, then supports the work in a way that makes it possible to enlarge the hole by means of a smooth, round file without damage to the rest of the reflector. The principal problem presented is that of soldering on the extension concentrically, but this may be achieved by the aid of a couple of concentric circles, scribed with an odd-legs calipers on the back of the reflector. One of these should be of same diameter as the extension or just a shade above, and the other so much larger that it will serve as a visible guide after the soldering has begun.

The screwed ring *A*, Fig. 1—as supplied with lamp-holders of this kind for the purpose of securing lampshades to them—serves, as already mentioned—as a lock-nut, thereby fixing the focussing adjustment obtained by screwing the lamp-holder more or less into the extension mounting. Insulated flexible conductors must, of course, be used. If the dished ring *B*, which fixes the back (or what remains of it) of the lamp holder to the body, is of such depth that it unduly limits this focussing adjustment, it should be faced-off in the lathe or by a file until only a turn or two of the screw-thread is left.

The bayonet pins on the bulbs, as purchased, may in some cases be found a shade too long to pass into the extension-piece, but it is only a moment's work to file or grind off any such

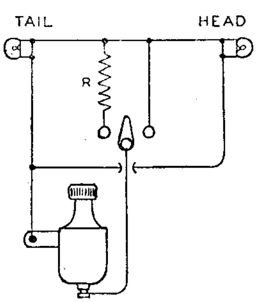


Fig. 7

unnecessary projection. If a spare bulb is bought it should be treated in this way, if it requires it, at or immediately after the time of purchase.

In some makes the reflector is semi-permanently fixed to the front of the lamp, a detachable push-in holder being used for the M.E.S. bulbs. In applying the conversion to lamps of this kind it is desirable to modify the means of reflector mounting to an extent which will make it easy to detach the same for the purpose of replacing bulbs. Why not make the new adaptor a push-in affair, you may say. Answer: because unless it was originally designed for S.B.C. bulbs, the orifice will be found too small. I am afraid that spinning over a lip to form a new cylindrical socket for a larger adaptor of the push-in kind would be a tricky operation without the use of specially formed supports for the work. To serve well at all, the push-in fitting must be a very exact or

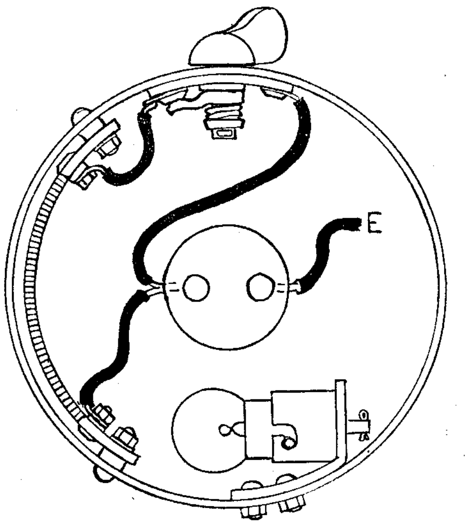


Fig. 6

somewhat springy fit and may become slack as a result of wear or vibration.

The exact nature of the modification to make the reflector detachable will depend upon the particular design. In some cases it may only mean adjusting a springy-wire fixing clip, or the lugs which secure it, to make it more easily removable than was originally intended. At the other extreme, a somewhat elaborate arrangement (actually carried out by the writer) is possible and may be desirable, namely to make the reflector a hinged fitting within the hinged front of the lamp. This was done by fitting to the reflector a light, flat brass bezel, to which a brass hinge had been silver-soldered, and securing this hinge to the inner surface of the lamp front (forward of its own hinge) by a pair of small round-head screws and nuts. The nature of the job rather precludes riveting. Diametrically opposite this hinge a similarly secured spring-clip is arranged to hold the reflector in the closed position. If the reflector so mounted shows any tendency to rattle a small rubber pad cemented in a suitable position may cure the trouble. Fig. 4 illustrates this modification. All this trouble, however, will only arise if it is thought particularly desirable to adapt an already-owned lamp whose other characteristics are so good that it is not wished to scrap it. In the case of adapting a battery lamp, for example, it will not occur. There may seem to be a certain pointlessness in all this in view of the possibility of purchasing a bicycle headlight

manufactured to take S.B.C. bulbs. The adaptation has, however, not only cheapness, but the possibility of further modifications—about to be discussed—to recommend it.

Insufficient room may be left, as a result of the modification, for carrying a dry battery for which a battery-holding clip within the lamp-house and change-over switch are in some dynamo headlights provided. If so, it seems to me, good instead of harm will have been done. Batteries so fitted, for occasional or emergency use, are more notable for causing corrosion of the internal parts of the lamp than anything else. If an auxiliary battery must be carried an outside receptacle for it is to be preferred, such as a neat little box in the angle between the steering pillar tube and cross-bar of the frame, or even a place in the saddle bag. In the former position it is a simple matter to modify the wiring and provide for switching over from dynamo to battery and *vice versa*, in a manner much superior to reliance on spring contacts within the lamp house. The fact that a two-way switch and some space within the lamp may thereby be left idle suggest another easily applied modification, namely the fitting of a resistance dimmer.

As to whether or not it is worth while to fit a dimmer, it may be mentioned that a properly focused and generally efficient dynamo head-light can give such a good beam of light as to be quite dazzling to an oncomer. Also, the act of dimming may earn a like courtesy from some if not all motorists. Incidentally, it may be mentioned that the type of lamp in which dimming is achieved by use of a second bulb located off centre, is not ideal for the adaptation ; neither is it a good arrangement in itself.

Fig. 6 shows a neat way of fitting a dimming resistance inside the lamp house, and using the two-way switch to switch it in and out of circuit (the "live" lead from dynamo to switch being omitted for clarity), while Fig. 7 gives the corresponding "theoretical" wiring diagram. For the resistance it would seem that about 10 ohms is suitable and such a resistance can be made by space-winding a suitable length of resistance wire on a strip of vulcanised fibre sheet, or even paraffin-wax-impregnated card-board, which may be anything from 3/8 in. to 3/4 in. in width, depending on the amount of wire that has to be accommodated. A tip for nicking the edges of such formers to suit spaced windings is to fix the blank in a vice and apply an outside chaser of suitable pitch, lightly tapping this with a hammer. As an alternative to building this fitment oneself, an old wireless rheostat may be used, dismounting and opening out the wire-wound strip, and fixing it into the lamp in the same manner as shown by Fig. 6, and of course there are other and perhaps even simpler expedients such as the use of one or other of the clip-in or screw-in resistance holders, familiar to radio-set builders. In the case of the open-type rheostat, tapping may be resorted to until the optimum value is found.

Assuming parallel winding of the head and tail lamps, it should be invariable practice to switch off immediately if the headlight fails, else the tail light will be overrun and quickly burn out. For the same reason a dimming resistance should not be wired in such a way that when it is used it causes overrunning of the tail lamp ; in other words it should be in a part of the "live" lead from the dynamo, which is common to both head and tail lamps, as shown in Fig. 7. Also, for the same reason and in the interest of generally efficient and reliable working, the frame of the bicycle should not be relied upon to serve as "earth" conductor, notwithstanding that commercial dynamo kits are almost invariably provided with a single wire and wiring instructions that assume this will be done. In the case of the headlamp there may be a dozen or more points between the bulb and the generator at which such an "earth" is liable to fail, due to imperfect contact or corrosion. It may be asserted without fear of contradiction that, next to poor quality M.E.S. bulbs, there is no more fruitful source of trouble in dynamo lighting sets than this one. By having a lesser number of mechanical joints between it and the generator than the headlight, the tail lamp may suffer less direct trouble from this cause, but with the concomitant risk of being overrun for this very reason. All of these birds can be killed with one stone by the expedient of using a light three-core cab-tyre flex as the "mains" of the system. It is doubtful that the slight increase in weight so occasioned could be of practical concern even to a racing cyclist. Fig. 8 shows a schematic arrangement of the theoretical circuit given by Fig. 7, applied in this way. With the exceptions of the earth-lead from tail lamp and connection between switch or switches and headlamp the conductors can be continous throughout, the outer insulation of the cab-tyre being stripped only as much at the ends as is necessary for

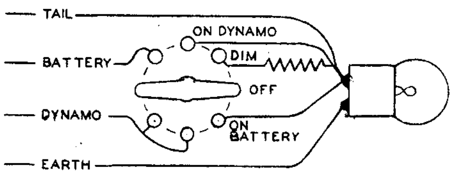


Fig. 9

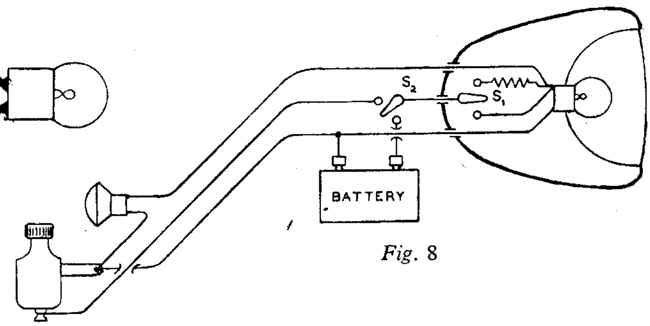


Fig. 8

separation of the cores and that without stripping the separate insulations of the latter.

If a battery is used as an auxiliary a second switch can be fitted as shown at S_2 in Fig. 8, S_1, being the dimming switch. One headlight overhauled by the writer had incorporated in it a rotary switch having six studs (i.e. three positions), in addition to the "off" position, by means of which it was possible to apply a really "posh" version of the scheme shown by Fig. 8, including battery circuit. This is diagrammatically illustrated by Fig. 9. It would be by no means difficult to make (if unobtainable ready made and cheap), and fit such a switch to any headlamp having a hole in top of it to receive a switch-knob.

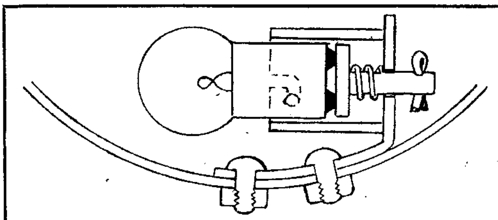


Fig. 10

In practice it will be found convenient to make the connections through terminals fixed in the shell of the lamp house. Except in the case of the "earth" these must be fixed in insulating bushings. Eye-tags should be soldered to the ends of the flex leads (both external and internal) for fixing them to the terminal posts, and "served" outside the soldering with tape or sleeving. If a single-contact system is used, a wire "earth" should still be employed, and its final connection in the headlamp should have a minimum of "dry" contacts between it and the bulb—"spotted" to the adaptor itself with solder or screw-fixed thereto being the best arrangement. Where these general recommendations are followed failure will be a rare occurrence, and when it does occur, easily located and almost as easily remedied unless it should happen to be within the dynamo.

Figs. 6 and 10 show a very desirable provision and its best location—namely that of a spare bulb carrier within the lamp house. The illustrations are self-explanatory, the materials being simply tube, sheet and odds and ends. The average dynamo headlamp affords clearance space for it in the position indicated. Thus, though an S.B.C. bulb may survive several years of use in the headlight, one will be prepared for every contingency.

Finally, if a battery lamp, having the usual box-shaped body behind the reflector housing, is to be adapted, the possibility exists of using a wireless rheostat of the compact kind which has a deep wire-carrier, and small diameter, to serve the combined duties of dimmer and on-off switch. In lamps of this type both ends of the box are usually detachable, and the bottom one can be adapted to carry the spare bulb. Since a battery of the usual large capacity is not required as an auxiliary to dynamo lighting it is a feasible plan to adapt one of the larger sized lamps of this kind to accommodate a small battery in addition to the switch and/or rheostat and spare bulb holder.

At any rate, by one or other of the means suggested, or by some other general plan which correspondingly takes into account the requirements and conditions of use, it is possible to make dynamo lighting for a bicycle thoroughly reliable. The average kit, with its flimsy single wire, is anything but reliable, and it is a commonplace to hear the dynamo blamed for the faults of its accessories and dynamo lighting, as such, condemned in consequence.

A Small Cutter Frame

(*Continued from page* 353)

The ends of the spindle were then case-hardened, also the coned ends of screws (B.)

The pulley (D) was made from a piece of cast aluminium and had two diameters, viz. 1½ in. and 1⅜ in., and was bored a press-fit for the ½-in. end of spindle.

The supporting bracket (Fig. 2) was made from a piece of 2½ in. × ⅝-in. thick angle iron, and was cut to the dimensions shown and provided with three slots, one ⅜ in. in width in the base for bolting to topslide, and two in the upright portion, 5/16-in. holes being first drilled at 7/16-in. centres, and then slotted out.

This enables the cutter frame to be raised or lowered by a considerable amount in conjunction with the five tapped holes in the back of bracket (A). Also, this bracket keeps the bottom portion of cutter frame to the left of saddle and gives plenty of clearance.

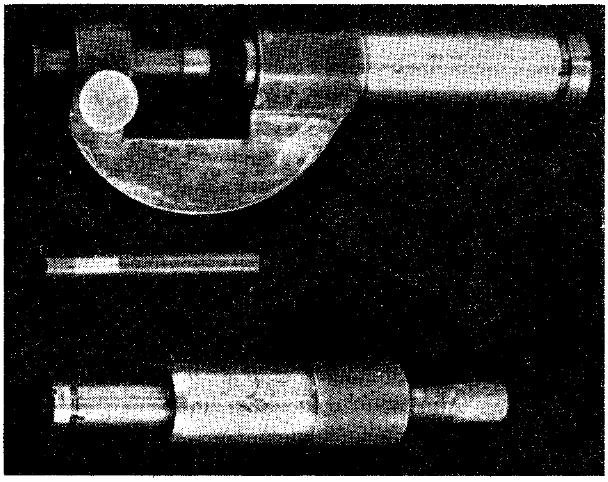
Photograph No. 3 shows the cutter frame set up on lathe for cutting clock wheel teeth. The motor, which is a small high speed d.c. one, is held by a metal strap with rubber insulation to a wood strip or beam which hinges on a ⅝ in. diameter steel upright attached to bench at rear of lathe, tension on the belt being provided by a spring attached to the other end of beam and also hooked on to lathe bed.

In Fig. 2 (E) shows where radius of angle has to be counterbored to accommodate head of set-screw.

An Unusual Micrometer

by T. W. Pinnock

IN the first place, I should explain that I am an inveterate haunter of junk-shops and always open to buy a "pup." However, the number of bad bargains I have acquired from time to time have not damped either my enthusiasm or my hope. Some time ago, in one of my favourite junk-shops, I saw a number of fragments of brass, which appeared to be part of some mechanism. By dint of patient sorting I managed to collect almost all the parts of the gadget which proved to be a somewhat elaborate form of micrometer. After a little bargaining I was able to acquire this for the modest sum of half a crown. which I feel is not unreasonable. My first job was obviously to assemble and examine my purchase, and having done so, I found that only one part was missing—the locking device on the "movable anvil." I replaced this by a 4-B.A. milled-head screw I had by me, and was then in a position to try the tool out.



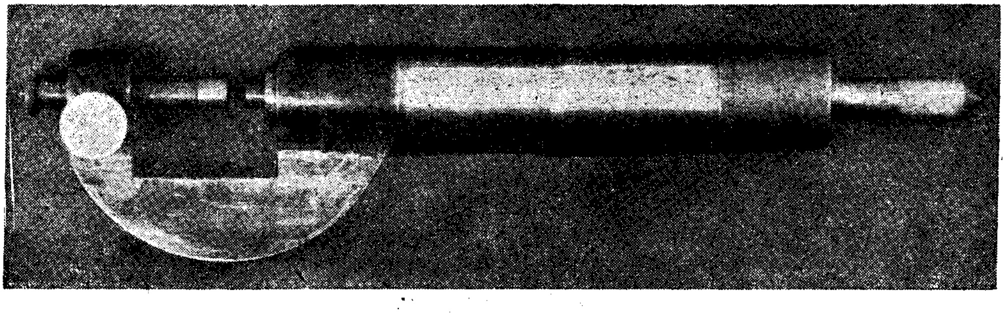
It is actually a differential screw micrometer reading to hundred-thousandths of an inch. The barrel of the micrometer—graduated on the outside, is tapped internally 40 threads per in. In this works a sleeve, threaded outside to mesh with the barrel screw, and inside to mesh with the anvil proper, threaded 50 t.p.i. To this sleeve is also attached an external sleeve, sliding over the barrel, and divided into 50 circumferentially—in a similar way to the usual form of micrometer. The anvil can move lengthways, but is restrained from rotating by a keyway.

As a result of this, one rotation of the sleeve moves it forward 1/40 in. = 0.025. The anvil, however, in rotation to the sleeve moves back 1/50 in. = 0.020, so that the total motion of the anvil is only 0.025 − 0.020 = 0.005 in. So each of the 50 divisions on the sleeve records 0.0001 in., and, by means of a vernier of the usual pattern, we can read to one tenth of this—or 0.00001 in.

It will be noticed that I have said throughout "we can read to"—not we can measure. In fact, there are a number of snags which prevent the tool in its present state from being so used to measure to these limits, or anything like them. The first snag is inherent in the design. The sleeve moves five times as far as the anvil. In consequence, for the anvil to move one inch the sleeve must move five inches, and the barrel is not long enough. To overcome this, the maker has fitted a "movable anvil," or, to borrow a lathe phrase, "tailstock," which can be brought in and locked to any position. As a piece of design this is not good. It is a very slack fit in its bearing and the locking, as far as can be gathered from the hole that is all that is left of it, is simply a setscrew. Moreover, the face of the tailstock is screwed on to its shaft, with apparently no provision to ensure any positive positioning.

Secondly, there is the question of backlash in the screw threads, and also in the keyway guiding the anvil. The screws are all beautifully made

(*Continued on page* 362)

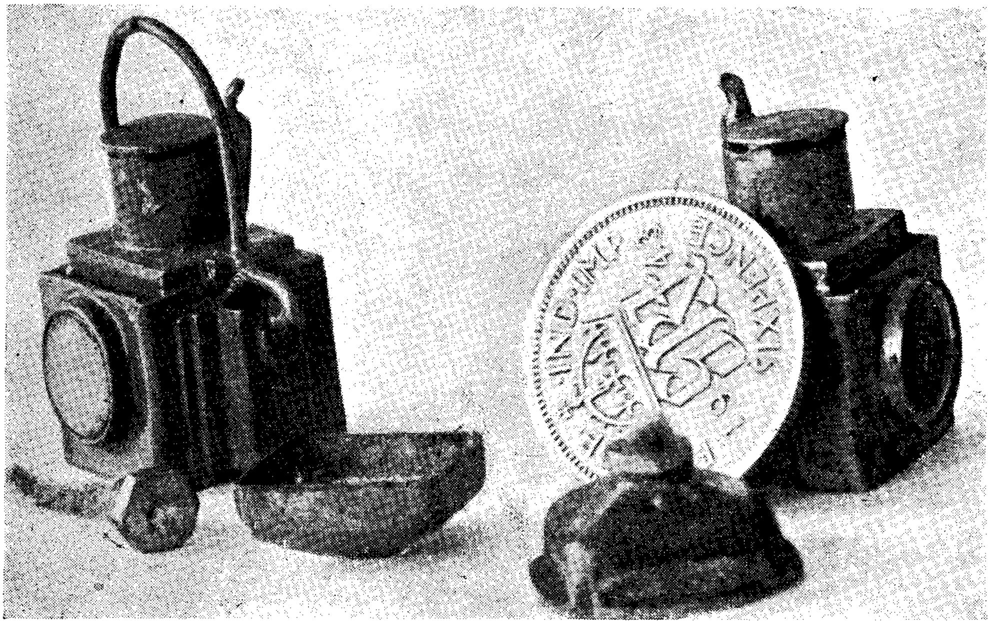


The Light that Failed

by "1121"

THE writer is of the opinion that it is the unsuccessful experiments which are of most value to other workers, and an account of some research in which only the successes are chronicled shows nothing but the insincerity of the *raconteur*.

When Mr. A. J. Maxwell expressed the desire to possess a set of dummy headlamps for his well-known 5-in. gauge G.W.R. locomotive, plans had not progressed very far before the temptation to endeavour to make real working lamps reared its head. Electric lighting seemed undesirable in view of the business of wiring-up the engine, and attention was turned toward the possibility of making them oil-burning. A scheme was evolved for the construction of the lamps, which is illustrated by the section Fig. 1. (Any interested reader is advised to consult Mr. Hambleton's description and drawings of the full-sized lamps in THE MODEL ENGINEER for May 7th, 1942, the particular pattern of lamp required being shown in Figs. 1 and 2 of his article.)



It will be observed from our drawing that a separate burner and oil reservoir was to be pushed up into the body of the lamp from the bottom. A number of containers were made successfully, in the form shown in Fig. 2. The main portion of the container was drawn up in one piece from some 0.010 in. copper foil which happened to be handy, by means of a punch filed to the internal shape, and a block of lead. The blank necessary for drawing up this shape is approximately as shown in Fig. 3. A hole was drilled at the apex of the pyramid, into which the little bush was silver-soldered, and the whole thing was silver-soldered to a piece of 1/32 in. brass at the same operation. A No. 60 hole was drilled alongside the bush for an air-vent. The container was stuffed with cotton-wool and filled with lamp oil, and the wick-holder fitted with its wick and screwed in. This burned with a beautiful little flame until the lamp body was placed over the top, when it promptly went out.

The reservoir had been made with well-rounded corners to allow of the entry of air into the body, and it was thought now that these vents were insufficient. They were therefore supplemented by $\frac{1}{8}$-in. holes drilled in each side of the body, where they would be hidden by the bracket-sockets, but there was no improvement. Further investigation revealed the fact that, due to the height of the container and wick-holder, the flame was burning, or rather trying to burn, in the confined space of the circular "chimney" at the top of the lamp, rather than in the greater spaciousness of the square part of the body.

One of the reservoirs was doctored to reduce its height, and this showed a definite improvement in the burning of the lamp, until it was found that if the wick were situated at about the level of the floor of the container, the lamp would burn with the body in place. These experiments had been conducted without the addition of the small circular "lid" covering the chimney, and when this was placed in position the flame became so temperamental that it would go out at the slightest disturbance, in spite of the air-space round the edge of the lid.

It was obviously impossible to make a lamp with the wick as low as was necessary, without

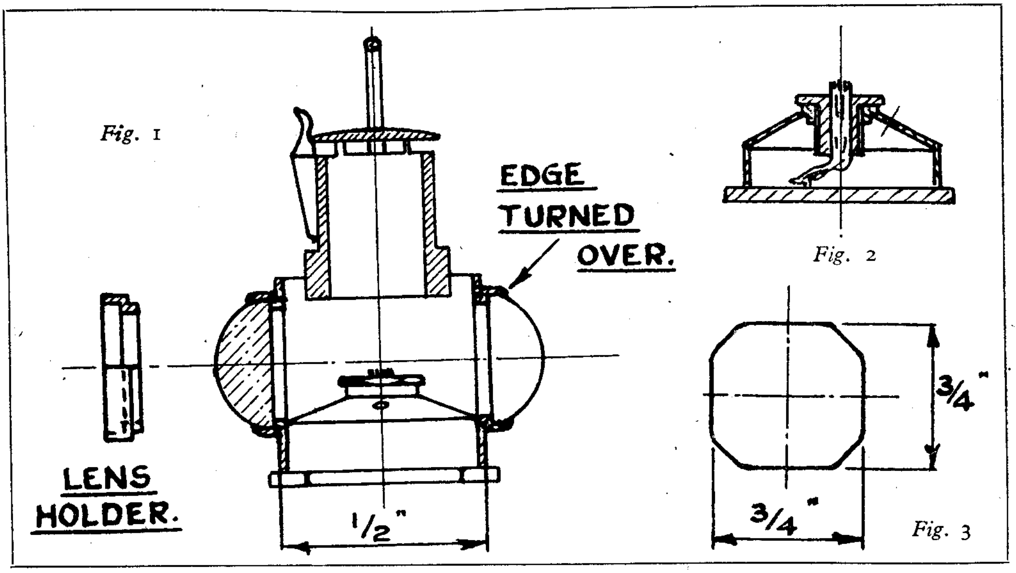


Fig. 1

Fig. 2

Fig. 3

exceeding the scale height of the body, and so we had to report to Mr. Maxwell that the attempt had been abandoned. In any case, even with a reservoir of the original capacity, the burning time of the lamp would have been so short as to be useless, except for the mere novelty of lighting them, and furthermore the heat generated even in this short time was prodigious, and would have put paid to any paint on the body, and probably the crinoid lenses, at the first time of lighting.

The lamps were therefore finished off, and the owner is quite happy that they look right, inside as well as out, even if they won't work.

An Unusual Micrometer

(*Continued from page* 360)

and fitted with adjusting nuts but—when one division on the vernier equals less than three-quarter of a degree angular motion of the sleeve, and there are two screwed joints and a keyway in which to lose motion, one feels a considerable doubt as to the reliability of the vernier.

Thirdly, and probably unfairly, the whole instrument is of brass. It is, as will be seen from the photograph, designed for use in the hand in the usual way, and in consequence, at its full opening of one inch nominal, the actual gap will vary for each degree of temperature change. This is, of course, assuming equal warming of all parts. What the effect of, for example, holding it in the hand by any particular part might be, it is impossible to say. However, as I have said, this is probably unfair comment, for it seems likely that the tool was made as an inventors or demonstration model, and that in the probably hoped-for production model, due precautions would be made.

An attempt was made by an experimental laboratory to test the tool. They reported that it was impossible to use it as a micrometer, but that by setting it to a reading, it could be used as an adjustable gap gauge and, so used, it proved to be accurate within three or four hundred thousandths of an inch. Considering everything, this seems very reasonable.

As regards the instrument considered as a piece of work, and not as a tool, the workmanship generally is very good. The screw threads and division lines are very neatly and cleanly cut and mechanically—apart from the "tailstock"—it seems excellent. Aesthetically, however, it is not so attractive. The square gap does not blend with the rounded bow, and the extension—where normally a ratchet is attached, is decidedly clumsy. The stamping of the figures on the body is not well done; though legible, they are out of alignment, and the knurling of the body is rather poor. These points, of course, have no bearing on the mechanical side of the job.

The obvious question, and one I have rather been dodging, is this. Is this sort of instrument any use to the model engineer? I can only say—which model engineer. If one wants to start splitting tenths of thousandths, and some i.c. and compression ignition people seem to be, then they probably can do with some such gadget. In that case, the differential screw device may be useful. Built up in steel as a fixed micrometer head, operated at long range by insulated knobs and rods, with the "tailstock" replaced by a fixed block and gauge blocks added, and with the whole in a glass case, it would probably do very close work. Nevertheless, if I had to take such measurements, I should be strongly tempted to use a single 50-t.p.i. screwed anvil with a 6-in. drum divided into 200 parts, and fitted with a vernier. As you dare not handle the tool in any case, size is no objection.